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ABSTRACT

Papers from the 1987 CAUSE conference on information technology in higher education are presented. They are organized according to the conference's seven concurrent tracks in the general areas of policy and planning, management, organization, and support services, as well as in the specialized areas of communications, hardware/software strategies, and applications. Current issues sessions and constituent group meetings are also summarized, along with vendor participation. The 49 papers include the keynote address, "Building a Campus Information Systems Environment" by David P. Roselle, which emphasizes commitment to the value of information technology in higher education, and the luncheon address by John G. Kemeny, "Computers Revolutionize the Classroom," which covers new developments in computing for classroom learning. Several black and white photographs illustrate the document. (LB)

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CAUSE

Leveraging Information Technology

Proceedings of the
1987 CAUSE National Conference

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December 1-4, 1987
Tarpon Springs, Florida

HE 021 556

Leveraging Information Technology

Proceedings of the 1987 CAUSE National Conference

December 1-4, 1987
Innisbrook Resort
Tarpon Springs, Florida

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CAUSE, the Professional Association for Computing and Information Technology in Higher Education, helps colleges and universities strengthen and improve their computing, communications, and information services, both academic and administrative. The association also helps individual members develop as professionals in the field of higher education computing and information technology.

Formerly known as the College and University Systems Exchange, CAUSE was organized as a volunteer association in 1962 and incorporated in 1971 with twenty-five charter member institutions. In the same year the CAUSE National Office opened in Boulder, Colorado, with a professional staff to serve the membership. Today the association serves almost 2,000 individuals from 730 campuses representing nearly 500 colleges and universities, and 31 sustaining member companies.

CAUSE provides member institutions with many services to increase the effectiveness of their computing environments, including: the Administrative Systems Query (ASQ) Service, which provides to members information about typical computing practices among peer institutions from a data base of member institution profiles; the CAUSE Exchange Library, a clearinghouse for documents and systems descriptions made available by members through CAUSE; association publications, including a bi-monthly newsletter, *CAUSE Information*, the professional magazine, *CAUSE/EFFECT*, and monographs and professional papers; workshops and seminars; and the CAUSE National Conference.

We encourage you to use CAUSE to support your own efforts to strengthen your institution's management and educational capabilities through the effective use of computing and information technology.

Leveraging Information Technology

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INTRODUCTION

As professionals in an always-exciting field, we are constantly facing challenges to blend new information technologies into our institutions. It is important for higher education to develop environments that promote the use of information technology for strategic advantages, that allow faculty, staff, and students to benefit from existing technology, and that stimulate the discovery of new opportunities.

The 1987 CAUSE National Conference, with its theme "Leveraging Information Technology," offered the opportunity for us to share, exchange, and learn of new developments in information technology to improve and enhance our environments. The CAUSE87 program was designed to allow the fullest possible discussion of issues related to these new developments. Seven concurrent tracks with 49 selected presentations covered important issues in general areas of policy and planning, management, organization, and support services, as well as in the specialized areas of communications, hardware/software strategies, and outstanding applications.

To expand opportunities for informal interaction, some changes were made in the program schedule. CAUSE Constituent Groups met the day before the conference, as they did in 1986, but were given opportunities to meet again during the conference. Current Issues Sessions were moved to Thursday afternoon to provide some flexibility with time, encourage interactive participation, and extend opportunities to continue discussions with colleagues. Vendor workshops were offered for the first time this year, the day before the conference. The Wednesday afternoon schedule accommodated continued vendor workshops, vendor suite exhibits, and concurrent vendor sessions.

David P. Roselle, President of the University of Kentucky, set the tone for CAUSE87 with a Wednesday morning opening presentation expressing his commitment to the value of information technology in higher education. John G. Kemeny, past president of Dartmouth College and currently Chairman of the Board of True BASIC, Inc., spoke during Thursday's luncheon of new developments in computing for classroom learning. The concluding general session, Friday's Current Issues Forum, offered an exchange of philosophies about making optimal use of technologies on our campuses.

We were extremely fortunate to be at Innisbrook, a resort with outstanding conference facilities and great natural beauty (and weather)—a real distillation of the best of Florida.

Almost 800 people attended CAUSE87. Many of them described the conference, in their evaluation forms, as stimulating, informative, and memorable. We hope this publication of the substance of CAUSE87 will be a continuing resource, both for conference-goers and for those who will be reading about the conference offerings for the first time.

Wayne Donald
CAUSE87 Chair

ACKNOWLEDGMENTS

The success of the CAUSE National Conference is due entirely to the contributions of many people and supporting organizations, several of whom deserve special attention:

The CAUSE87 Program Committee

This committee, under the chairmanship of A. Wayne Donald and vice chairmanship of James Strom, spent many hours working with the CAUSE staff to produce an effective conference. CAUSE gratefully acknowledges their enthusiasm, time, and efforts, and the generous support of their institutions.

Front row, left to right: Wayne Donald, Virginia Tech; Carole Barone, Syracuse University; Andy Wehde, University of Iowa. Second row: Richard Howard, North Carolina State University; Jim Strom, California Polytechnic State University; Stephen Patrick, University of Wisconsin, Stevens Point; Frank Weiss, Barnard College; and Dennis Kramer, Ball State University. Not pictured: George Bosela, Macalester College; Cheryl Munn, University of Michigan; and Frank Thomas, University of Akron.

CAUSE President Jane Ryland presents a special token of appreciation to CAUSE87 Chair Wayne Donald—a figure of a golfer made from Wayne's business cards.

1987 CAUSE Board of Directors

Front row, left to right: Judith W. Leslie, CAUSE Past President, Maricopa Community Colleges; Cedric S. Bennett, CAUSE President, Stanford University; M. Lewis Temares, CAUSE Vice President, University of Miami. Second row: Thomas W. West, The California State University; Jeffrey W. Noyes, Mercer University; Bernard W. Gleason, Boston College; David L. Smallen, Hamilton College; and Wayne Ostendorf, CAUSE Secretary/Treasurer, Iowa State University.

The contributions of time and creative energy of the CAUSE Board of Directors are gratefully acknowledged and appreciated. Retiring from the 1987 CAUSE Board was Wayne Ostendorf of Iowa State University, pictured (right) receiving his recognition plaque from President Ced Bennett.

Two members whose three-year terms have expired will continue to serve on the Board in 1988: Cedric S. Bennett of Stanford University, who was CAUSE Secretary/Treasurer in 1986 and President in 1987, will serve in an *ex officio* capacity for one year. Judith W. Leslie of Maricopa Community Colleges, who served as President in 1986, will fill the remaining two years of the term vacated by Robert G. Ogilvie when he left the American University.

Contributing Vendors

CAUSE thanks all those vendors who set up suite exhibits, gave company presentations, and provided evenings of hospitality. Their contributions add an enormously valuable dimension to the conference experience.

Special thanks go to **Peat Marwick** and **Information Associates** for providing the pre-conference tennis and golf tournaments; **Digital Equipment Corporation** for underwriting the opening night Registration Reception; and **Apple Computer** for providing a Macintosh computer and LaserWriter printer for on-site registration needs; and to **Apple Computer**, **Control Data Corporation**, **Century Data Systems**, **EDUTECH International**, and the **IBM Corporation** for their sponsorship of refreshment breaks, breakfasts, and luncheons.

CAUSE Member Committees

Neither the conference nor the other association activities could continue without the contributions of the six creative and active CAUSE Member Committees. CAUSE appreciates the time and energy contributed by the volunteers who carry out the duties of these committees. At the Wednesday luncheon, CAUSE president Cedric S. Bennett thanked the many people who supported the association in 1987 through participation on association committees, and presented plaques containing certificates of appreciation to individuals retiring from committees:

For service on the *Current Issues Committee:* George Bosela, Macalester College, and William Compton, Mercer University.

For service on the *Editorial Committee:* Deborah Teeter, University of Kansas; Ann Thorsen, Michigan State University; William Walden, University of Wyoming; and Michael Zastrocky, Regis College.

For service on the *Election Committee:* Sandra Dennhardt, University of Illinois; John Monnier, University of Arizona; Samuel J. Plice, University of Michigan; and Corrine Fields, Rice University.

For service on the *Recognition Committee:* James L. Morgan, Pepperdine University, and Richard Whiteside, University of Hartford.

The newly-established *Member Liaison Committee* had no retiring members.

The *Program Committee*, all of whose members received recognition plaques, was complimented for its fine work on the conference. Special tribute was paid to Chairman Wayne Donald for his diligence and enthusiasm.

GENERAL SESSIONS

CAUSE87 offered several opportunities for all conferees to convene in general sessions which addressed topics of common interest. The conference opened with an orientation session offering an overview of CAUSE as an association as well as advice from CAUSE87 Chair Wayne Donald on how to "cover" all the activities of the conference.

Two excellent speakers on education and information technology presented general-session addresses on Wednesday morning and at the Thursday luncheon.

Recipients of CAUSE awards were honored during the Wednesday Awards Luncheon. During the Thursday morning CAUSE Annual Business Meeting, new Board members were announced, bylaw changes provided for changes in titles of CAUSE officers, and a slide presentation, *CAUSE: Your Professional Association*, summarized activities of the past year.

The final general session of CAUSE87 was a Current Issues Forum, *Leveraging Information Technology—Expectations vs. Reality* .

WEDNESDAY MORNING
KEYNOTE ADDRESS

Building a Campus Information Systems Environment

David P. Roselle
President
University of Kentucky

Keynote speaker for CAUSE87 was David P. Roselle, President of the University of Kentucky, who drew from his experience at Virginia Tech and Kentucky in an informal, humorous address reflecting his commitment to the value of information technology in higher education.

Dr. Roselle focused on the development of management and budgetary strategies for computing, software, and communications designed to support the academic and administrative requirements of a large, educationally diverse institution with multiple locations.

THURSDAY LUNCHEON
GENERAL SESSION PRESENTATION

Computers Revolutionize the Classroom

John G. Kemeny
Chairman of the Board
True BASIC, Inc.

During Thursday's luncheon, general session speaker John G. Kemeny, Chairman of the Board of True BASIC, Inc., focused his talk on the necessity for long-term planning and cooperation between universities and the suppliers of computing technology in the development of effective software and systems.

Dr. Kemeny, one of the developers of the BASIC computer language, was also president of Dartmouth College from 1970 to 1981. His slides and examples illustrated his strong belief in the importance of the computer for classroom enrichment.

WEDNESDAY LUNCHEON AWARD PRESENTATIONS

Highlighting this luncheon were the presentations of the 1987 CAUSE Recognition Awards and the CAUSE/EFFECT Contributor of the Year Award, with special acknowledgment of award sponsors Information Associates and Systems & Computer Technology Corporation. President Ced Bennett presented a plaque to retiring Board member Wayne Ostendorf in gratitude for his excellent service to the association.

Left to right, Ced Bennett, CAUSE President; Frank B. Campanella, Executive Vice President of Boston College, who was recognized for his leadership at Boston College; James I. Penrod, Vice President for Information Resources at the California State University/Los Angeles, recognized for leadership at the national level; and John Robinson, President of Information Associates, sponsor of the awards.

Linda H. Fleit, President of EDUTECH International, is congratulated for her selection as recipient of the CAUSE/EFFECT Contributor of the Year Award by Michael J. Emmi, Chairman and CEO of Systems & Computer Technology Corporation, who sponsored the award.

WEDNESDAY LUNCHEON COMMITTEE RECOGNITION

Retiring committee member Stephen Patrick (University of Wisconsin/Stevens Point) receives thanks for his services from CAUSE President Ced Bennett.

THURSDAY LUNCHEON INTRODUCTION of 1988 CAUSE BOARD

Above: ***Ced Bennett passes the gavel to new CAUSE Chair M. Lewis Temares.***

Above right: ***Ced with new executive officers Secretary/Treasurer Bernard W. Gleason (Boston College), Chair Lew Temares (University of Miami), and Vice Chair David L. Smallen (Hamilton College).***

Below right: ***New Board members Carla T. Garnham (Medical College of Wisconsin), Robert C. Heterick (Virginia Tech), and Michael R. Zastrocky (Regis College).***

FRIDAY GENERAL SESSION
CURRENT ISSUES FORUM

Leveraging Information Technology—Expectations vs. Reality

George Bosela of Macalester College and 1987 chair of the CAUSE Current Issues Committee moderated this two-hour discussion which concluded CAUSE87.

The first panelist, *Robert Heterick* , Vice President for Information Systems at Virginia Tech, pointed out that the accelerating migration of applications from mainframes to personal computers is creating a significant conflict in the tradeoff between institutional control of data and perceived value for the user in local storage and processing. Evidence of this situation is the fact that many of the sessions at CAUSE87 were permeated by manifestations of this issue.

Kenneth King, President of EDUCOM, said that the grand challenges for technology in the coming decade include (1) building a world university network, (2) building a knowledge-management system on the world university network, and (3) building state-of-the-art administration systems at universities. Meeting this third challenge is extraordinarily difficult because the list of expectations always grows faster than implementation resources, and the systems required are both extremely complex and located in environments (colleges and universities) which are poorly suited to cost-effective systems. Moreover, the technology is changing so rapidly that many systems are obsolete before they are completed.

Good administrative systems are strategic, King said—a good admission tracking system can help a college or university locate its natural prey; good student services produce happy future alumni, and happy alumni produce!

Richard Whiteside, Assistant Vice President of Academic Administration for the University of Hartford, described the university culture as not really oriented toward relying upon information—"real men don't do data." To encourage more effective use of available data, he said, we should be actively going out into the university community and helping to identify who needs to know, explaining why they need to know, and showing them how to find out. The computer services staff must actively seek to participate in processes which chart the university's future. And our orientation needs to turn away from sophistication for its own sake and toward facilitating the university's primary goals: teaching and research.

Whiteside cautioned that, while we have tried to think of everything to ensure that our systems will be around for some time to come, we are dependent upon hardware and software vendors to realize this objective. He expressed concern that we have neither reaped full benefit from our technological investments, nor are in a position to turn our full attention toward other pressing institutional concerns.

BOB HETERICK
DICK WHITESIDE
KEN KING

PROFESSIONAL PROGRAM

The CAUSE87 theme, "**Leveraging Information Technology**," was addressed through forty-nine professional presentations in seven subject tracks, as well as through five Current Issues Sessions, less formal sessions on topics of special interest. Seven Constituent Groups met to exchange information and experiences pertaining to specific working environments.

The papers on which the professional presentations were based, and summaries of the Current Issues Sessions and Constituent Group meetings, are printed in the following pages.

Current Issues Sessions

Five scheduled Current Issues Sessions provided informal opportunities for conferees to meet and exchange ideas on topics of special interest or concern. The topics were chosen from issues which have been of interest to CAUSE members in the past year.

Implications of Choosing a Network Strategy
Moderator: M. Lewis Temares
University of Miami

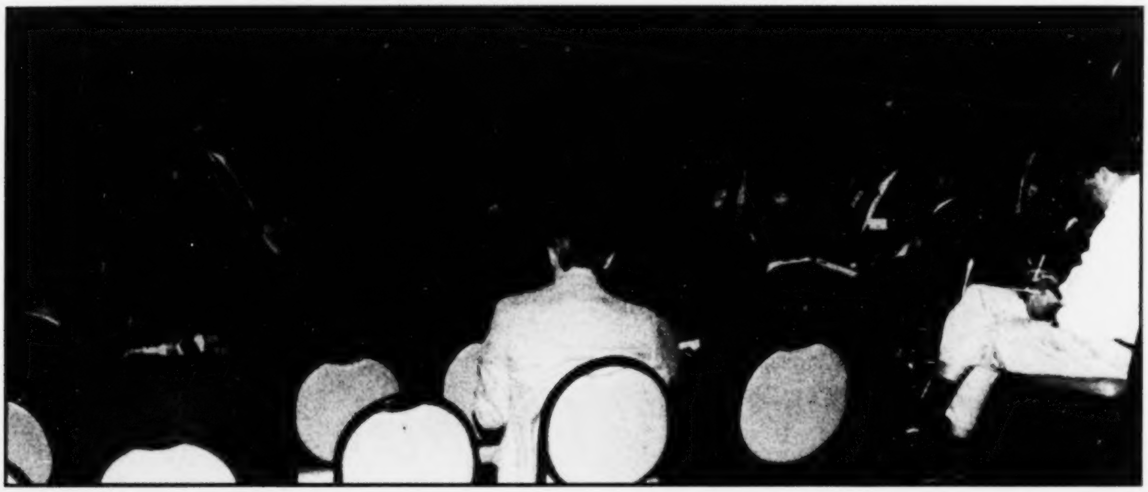
Security and Access Issues
Moderator: E. W. Carson
Virginia Tech

* **Integrating PCs with Mainframes for Cost Efficiency, Effectiveness, and Management**
Moderator: Michael Langrehr
Maryland State College &
University System

Decentralizing the Environment in the Truest Sense
Moderator: Ronald D. Hay
Louisiana State University

Software Contracts and Site Licenses
Moderator: Jerry Sprecher
California State University/
Long Beach

* *Summary not available.*



CURRENT ISSUES SESSION SUMMARY

Implications of Choosing a Network Strategy

Moderated by
M. Lewis Temares
University of Miami

The implications of choosing a network strategy were discussed from an institutional and departmental perspective. Participants in the session agreed upon the importance of involving faculty, students, administrators, and outside consultants in planning.

Issues raised during the course of the discussion included

- organizational change
- the inability to find competent voice and data staff
- revenue enhancement and generation
- starting your own telephone company
- reporting of unrelated business income
- digging up of the campus
- transmission media and rates
- rapidity of technological change
- paying for services and data connections
- amortization of hardware and software
- support from upper management
- lack of vendor support
- similarities to managing centralized computing services

Participants gave examples from their own experiences and sought solutions from those who had ventured forth and trail blazed.

CURRENT ISSUES SESSION SUMMARY

Security and Access Issues

Moderated by
E. W. Carson
Virginia Tech

The Current Issues Session on Distributed Access to Administrative Systems was well attended and involved spirited discussions. A wide range of practices and concerns was presented. Questions raised included: What are the legal issues related to the electronic access of student, personnel, and budget data? What are the responsibilities of the administration and of individuals when distributed access is provided?

The census conclusions seemed to be as listed here:

1. Distributed access is desirable!
2. Distributed access can be provided.
3. Both institutions and individuals are responsible for "reasonable and prudent" security of the data.
4. Absolute security is not possible or cannot be justified on the basis of cost/benefits or on the basis of loss of essential services. Individuals, not offices or devices, should be authorized for access.
5. Authorizations should be confirmed for every transaction, every data request, and every change in target data.
6. The authorization process should include appropriate training in security and issues of confidentiality.
7. The authorization process should include an acknowledgment (signed statement of acceptance of the policies and responsibilities.) At least one institution requires such clearances.
8. Consideration must be given to privacy and the rights of individuals with respect to access and use of personal data.
9. Access should be controlled by data values associated with both the requestor and the target data.
10. Audit trails should be maintained for all critical updates and accesses to sensitive data.
11. The fact that data can be intercepted or browsed during transmissions (especially on some LAN systems) must be recognized and addressed in planning a delivery system for distributed access.
12. Data encryption may be desired in some communication systems. (At least one school reported that such encryption was required for all personnel and budget data.)
13. A centralized role of Data Administration could help in controlling and auditing security-related issues.
14. Point source data capture and data responsibility should be emphasized.
15. Real-time data are not critical for most management decisions, especially those relying on aggregate data.
16. Real-time data are essential to most processing of information for individuals.
17. Real-time data and census-date data should both be provided by distributed access.
18. Data for a single request need could reside in several data files, be maintained by more than one DBMS, and could even reside in more than one machine.
19. Standards (security, data dictionary, request languages, communication protocols) are essential for future full development of distributed access to administrative data.

CURRENT ISSUES SESSION SUMMARY

Decentralizing the Environment in the Truest Sense

Moderated by
Ronald D. Hay
Louisiana State University

Session participants were in general agreement that "decentralizing the environment" made good sense if the institution had a carefully-developed plan that really addressed the issues of decentralization. There was consensus that decentralizing the environment in the truest sense meant that the organization had to solve problems related to:

- data security and integrity
- redundancy of staff, equipment, and data
- hardware and software compatibility
- communications standards and protocols
- staff recruiting, training, promotion, and retention in a decentralized environment
- effective budgeting to support on-going decentralized operations
- auditability of decentralized data bases
- etc.

Most participants admitted that they were involved in efforts to decentralize their own professional environments. Individuals felt, however, that many of their short-term paybacks might be offset by the problems and issues previously outlined.

It was agreed that this issue would continue to be a "hot" topic for future conferences.

CURRENT ISSUES SESSION SUMMARY

Software Contracts and Site Licenses

Moderated by
Jerry W. Sprecher
California State University/Long Beach
and Steven W. Gilbert
EDUCOM

After an introduction by Jerry Sprecher, Steve Gilbert reviewed pertinent activities of various task groups in the EDUCOM Software Initiative (ESI). These activities included Intellectual Property Rights (Task Group 4) and the "Using Software" brochure.

Mr. Gilbert reported that the EDUCOM Board had recently supported seed money for continued activities by Task Group 4 in identifying and establishing relationships with other organizations (e.g. law schools) interested in the intellectual property rights issues. In addition, the Task Group will explore the potential for publication of exploratory material in 1988.

The ESI and ADAPSO, the computer software and services industry association, have distributed over 125,000 copies of the Using Software brochure. The brochure contains information about the legal and ethical use of software in higher education.

After a brief discussion, Mr. Sprecher reviewed some of the techniques utilized by California State University in negotiating contracts with hardware and software vendors. They included:

- leverage based on size,
- one point of contact,
- specialization centers, and
- partnerships or "win-win" relationships.

An extended group discussion followed in which the experiences of the group members were discussed and compared. Small-campus versus large-campus strategies, centralized procurement and standardization versus departmental autonomy, and procurement language were major topics.

At the close of the session, Mr. Sprecher invited the participants to attend the Legal Issues in Academic Computing seminar scheduled for February 19 in California.

Constituent Group Meetings

Seven subgroups of CAUSE members and conferees met at CAUSE87 to focus on issues unique to their shared work environments. These Constituent Groups are organized to encourage communication among professionals who share specific problems and functions. The groups meet during the National Conference, and occasionally at other times during the year, and the number and focus of the groups change according to members' needs.

Chief Information Officers

Convenor: *Joseph A. Catrambone*
Loyola University of Chicago

The CIO group in higher education, which has met twice in Chicago since 1986, provides a forum for sharing experiences in planning, utilizing, and managing information technology in higher education. Contents of prior CIO meeting agendas were briefly discussed and included the functions, responsibilities, and reporting of the CIOs, as well as policy issues relating to planning, budgeting, networking, and telecommunications.

Inquiries by the group aroused interest in and discussions of the relationship between the CIO and various campus committees, the institution's board of trustees, and state governments.

Community/Two-Year Colleges

Convenor: *Gordon Mathezer*
Mount Royal College

A recurring topic of discussion was end-user support services—pros and cons of various models and the role of advisory/steering committees as the needs for training, problem-solving, and consulting increase.

Another issue was that of integrated administrative systems, and the problems of working with old, incompatible systems. Most of the institutions represented at the meeting are finding renewal and upgrading very difficult and costly. A minority of the group use 4GLs to help solve the problem; most are considering software packages rather than building large systems inhouse.

Microcomputers are having a major impact at all these institutions, and defining responsibilities for acquiring, using, and supporting them is a critical task. Several institutions have found that doing their own hardware maintenance is economical.

Data Administration

Convenors: *Richard D. Sheeder*
Penn State University
and *Leonard M. Brush*
Carnegie Mellon University

Four brief presentations were made during this session to provide real-life data administration perspectives from four different types of institutions or organizations: Penn State University, the South Dakota Board of Regents, the Oregon State System of Higher Education, and Carnegie Mellon University.

Questions focused on the need for written policies on data administration and procedures for providing access to data. Attendees urged the continuance of the group, and agreed to conduct two surveys: one to establish a glossary of terms used in the data administration environment, and the second to collect and analyze data administration policies in institutions and state systems of higher education. Development of a CAUSE monograph on data administration was proposed.

Institutional Researchers and Planners

Convenors: *Deborah J. Teeter*
University of Kansas
and *Richard D. Howard*
North Carolina State University

This meeting generated a spirited discussion identifying topics of interest to those in attendance. Suggested topics included:

- the role of Institutional Researchers in developing computer plans
- micro-mainframe connections
- end-user computing support
- management techniques
- information flow

In discussing the format of future meetings, participants expressed a preference for using such opportunities to identify issues that should be further discussed on their own campuses rather than establishing a formal agenda.

Medical/Health Science Centers

Convenor: *Linda Heidel*
Stanford University Hospital

This meeting provided opportunity for representatives of medical centers to share information about their information systems environments.

After a comparison of organizational structures represented at the meeting, it was clear that business-oriented personnel are replacing technical experts, and that all share three basic problems: the needs to replace old architecture and software, to develop a strategic plan, and to develop system interfaces. Development of a strategic planning process was conceded to be key to solving the other problems.

The next meeting of this group will focus on strategic planning, user community education, and professional development for data processors, and may include a presentation on how to do strategic planning.

Multicampus/State Systems

Convenors: *Erwin Danziger*
University of North Carolina
and *Stewart Robinovitz*
University of Michigan

This group focused discussion on issues of central vs. local control of various activities including staffing, user services, software and hardware, and budgeting. Two distinct constituent groups were present: large multi-campus single- institution systems, and statewide multi-institution systems. The discussion was centered on the former group, and the latter group felt the need for a separate group in the future.

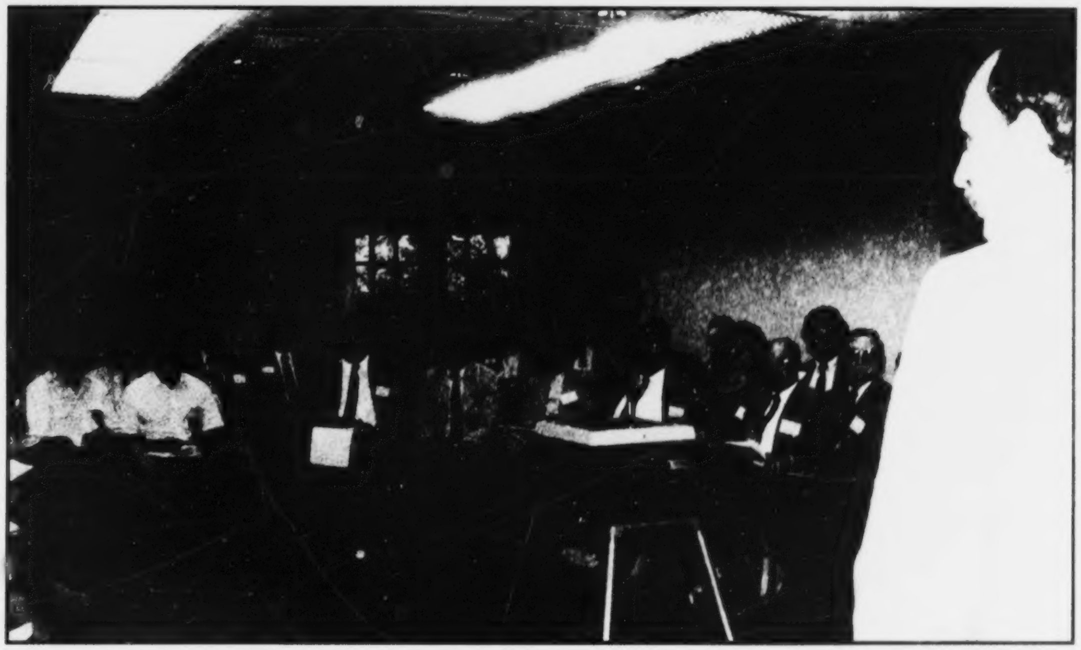
Small Institutions

Convenor: *Mike Zastrocky*
Regis College

There was a good turnout of participants at this meeting, and lively discussion of the current status of computing at each institution.

Many of the attendees shared experiences with turnkey packages and the installation process and problems associated with installing a new system. There was some discussion of the experience of users with PCs. Several handouts were provided by Pacific Lutheran University and Santa Clara University.

Overall, participants believed that it was important to continue the communication provided by constituent group sessions, and the moderator assembled a list of the participants and offered to pass along information as it is received.



Track I

Policy and Planning

Coordinator:
Richard Howard
North Carolina State University

Because of the magnitude of potential commitments for new technology, planning for growth must be long term, with flexibility to take advantage of innovations. The concomitant policy issues, which tend to focus on internal concerns of who, for what purpose, and how, must also be recognized if the institution is to leverage information technology to its greatest benefit.

Papers in this track address the policy and organizational issues implicit in these conditions.

Edwin J. Merck
University of Rochester
Eastman School of Music

Mary M. Sapp, University of Miami; Gerald W. McLaughlin, Virginia Tech; Deborah J. Teeter, University of Kansas; Richard D. Howard, North Carolina State University

Is Higher Education Too Old For Technology?

Linda H. Fleit
EDUTECH International
120 Mountain Avenue
Bloomfield, Connecticut 06002

Edwin J. Merck
Eastman School of Music
University of Rochester
26 Gibbs Street
Rochester, New York 14604

In far too many institutions, there is a lack of integration between institutional and computing goals, with neither of them designed to work together as a unified global strategy. On one hand, institutional goals rarely recognize the advantages and the limitations of technology; on the other hand, computing goals themselves become ends, rather than means to furthering the institution. This is one of the symptoms of several that this paper will cover in discussing difficulties in our institutions' ability to leverage information technology in the most effective ways. We propose that the reason for these difficulties is a fundamental mismatch in life cycles between higher education and technology. Using this premise, we offer suggestions to bring the two closer together, leading to better vehicles for communication, more educational opportunities for both university management and computer people, and overall continuity in the formation and implementation of goals.

The theme of this conference is "Leveraging Information Technology." Implicit in that title is the recognition of an undefined problem, one of the symptoms of which is the general level of dissatisfaction with the impact technology has had on education. Also implicit in the theme is the hope that this conference will identify the "problem" and offer up suggestions so that, in the future, education will see greater rewards from technology. In this paper we take that challenge seriously and attempt to detail the symptoms, identify the problem (or at least a structure for understanding the problem) and offer up suggestions for addressing the problem.

SYMPTOM: Relatively small impact of technology

We have been saying for years that technology has the potential to change our institutions dramatically; if leveraged properly, technology could substantially increase not only the efficiency and effectiveness of the institution, but also the very nature of its approach. And yet, the impact so far has been relatively small except on the budget and the physical presence of hardware around campus. This combination has served only to increase the suspicion by University executives that return on investment in computing is very low. And, the patience of these "resource allocators" is wearing very thin.

SYMPTOM: Lack of integration between institutional goals and technological goals

Despite the recent emphasis in education on long-range planning, there seems to be very little global thinking going on -- at least not of a unified nature. Institutional goals and technological goals are developed and implemented with little sensitivity to, or awareness of, each other. Technology fails to support the efforts of the policy makers and the policy makers fail to understand or to take advantage of technology. The result is a fractured strategy which leads to a lack of unified institutional movement.

SYMPTOM: Defensive behavior on the part of executives and computer people

Executives and computer people are often in the wrong business -- preserving the power and influence they have gained over the years rather than applying their combined efforts to create stronger institutional unity. On the one hand, executives maintain power by further tightening an already rigid organizational structure. Unfortunately, rigid, hierarchical structures, while preserving power, also impede the flow of information and deter managers from being open to new ideas and/or change. Computer people, on the other hand, hold on to power by continuing the myth of their uniqueness - "Here is a discipline that only we can understand." This behavior fosters an attitude in which computing goals become understood as being ends in themselves rather than a means of furthering institutional growth. The combined defensive postures of these two groups provides for an information jam, negating the very essence of what technology is designed to enhance. Further, this attitude of defensiveness is antithetical to the behavioral core necessary for institutional movement - creativity, experimentation, openness to opportunity, and their byproduct - innovation. Ironically, the potential for technology to make information available to greater numbers is defeated. The resistance is great, and it is also clear that any attempt to "flatten" the organizational structure could intensify the defensiveness by threatening the sanctity of executive power and blurring the uniqueness of the computer lords.

SYMPTOM: Lack of executive involvement with technology

If you don't ask, you won't get. Or -- if executives are not involved in defining what information is necessary for decision making, they will not receive the requisite information from the computer people. Computer people are trained in how to get information, not what to get. Only management has the vantage point and the responsibility to specify the information that is needed to support progress on institutional goals.

Currently, many executives put more energy into avoiding involvement with technology than actually engaging in an exchange between manager and technologist. For example, few people at the top have "hands on" knowledge of computers or computing and thus display an approach that is detached and seemingly ill-informed. They create powerless committees to "study the issues," and to "make recommendations" which only serve as a barrier from the issues surrounding technology. Creating "computing czar" positions is another favorite way to isolate the decision-makers from technology.

Besides avoiding involvement, many current executives have difficulty in determining and articulating institutional goals. "You can't support something if you don't know what it is," say the computer people. "It's not our job to decide what direction this institution is going in. Tell us what you want and what format it should be in and we'll get it for you." This combination of ill-defined goals and lack of executive involvement serves to diminish meaningful communication. The result is a fragmented institutional vision and varying, often competing, perspectives.

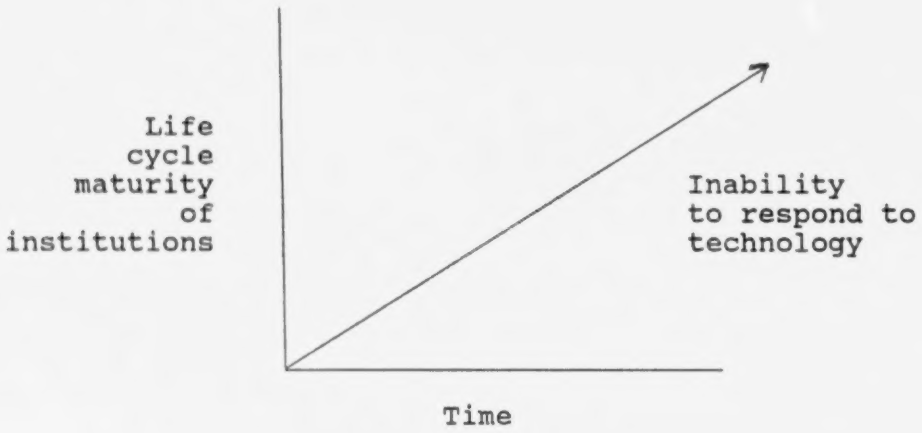
So far we have identified four symptoms: relatively small impact of technology on education; lack of integration between institutional goals and technology goals; defensive behavior on the part of executives and computer people; and lack of executive involvement with technology. Modern techniques of analysis dictate that before seeking a solution(s), the cause or underlying problem reflected in these symptoms must be understood. In order to understand the problem, it is imperative that a framework be developed in order to reduce the open-ended ambiguity to a tangible working structure. In other words, a synthesis of broadly defined symptoms into a concrete cause or problem can more easily be accomplished with the help of a cognitive framework. We call our framework "the life cycle mismatch."

All institutions, people, and living things in general go through life cycles. These life cycles can be divided into various stages, each of which is accompanied by predictable characteristics. Probably the most simplified understanding of life cycle theory would include the stages labeled early, growth, and mature. The early stage is generally characterized as flexible, open-ended, new, changeable, innocent, malleable, fluid, creative, and other like adjectives. The growth stage takes the animate object over time to the mature stage, usually characterized as well developed, systematic, rigid, cautious, protective, predictable, etc.

What part of the life cycle are our educational institutions in today? Or, more appropriately, what kind of environment do they present in which technology can develop? Any answer to that question is certainly an overgeneralization and a bit of a risk, but there are some subjective observations which do indicate a response. In general, we feel that many, if not the majority, of educational institutions are in the mature phase of their life cycles. Our educational institutions seem to reflect many of the adjectives used previously to describe that stage: systematic, rigid, protective, cautious and predictable. Further, there are many manifestations of this behavior, such as a well defined hierarchical decision-making structure; a highly structured communications network which supports the status quo and discourages new or certainly radical ideas; a rigid promotion and compensation system based on tenure and unionization; and a power structure that is defensive in posture and lacking in fluidity.

The next logical question is: What type of environment does technology need in order to flourish? Or, more appropriately, what phase in the life cycle of educational institutions would support the greatest leveraging of technology? If technology -- at least our modern computer-oriented version -- is anything, it is new and undeveloped. Change is ever present, calling for an open-ended, unstructured approach. Technology needs a flexible, fluid environment which encourages experimentation and risk-taking -- in short, all of the characteristics found in the early stages of typical life cycles.

By now the conclusion and thus our definition of the problem is obvious. We observe a mismatch between the environmental characteristics offered by educational institutions in the mature part of the life cycle and what is needed by technology -- characteristics more typical of the early stage of a life cycle. In other words, technology and the educational institutions which provide its environment are out of phase with each other causing a negation of many of the potential advantages technology has to offer. Technological innovation is only as good as the ability and willingness of its environment to support and integrate its features. A simple graph plotting the life cycle maturity of educational institutions over time shows an ever increasing area that can be defined as the inability of these institutions to respond to technology.



In summary, all of the symptoms observed earlier in this paper can be understood as the result of the life cycle mismatch between our educational institutions and technology. If pressed to invent an alluring title for a paper that would describe these relationships, one could envision -- "Is Higher Education Too Old For Technology?"

The final part of this paper offers up a number of suggestions to help address the problem. We have taken our cue in crafting the suggestions from our definition of the problem. Accordingly, the suggestions all cluster around ways to encourage educational institutions and the people who manage them to behave in ways more characteristic of early life cycles. And, in general, the suggestions indicate motivators that reward creativity and risk-taking while discouraging rigidity and defensiveness.

Suggestions

Obviously, there isn't much we can do to change the fact that higher education has been around much longer than computer technology, and is, therefore, more prone to take on the characteristics of the later stages of the life cycle. But what we can do is to encourage our institutions to take on more of the trappings of earlier stages, in order to bring these two better into harmony. Without greater harmony, our institutions will continue to be unable to respond to the changes that are happening around them, and even more important, will continue to be largely unable to take full advantage of technology.

The suggestions we offer are ones that tend to focus on the most positive characteristics of the earlier stages in an organization's life cycle. These include a generally freer information flow, a somewhat looser organizational structure with less hierarchy and segmentation, more of a positive attitude toward risk-taking, more in the way of sideways communications, and more of a results (rather than a process) orientation. In younger organizations one tends to find less bureaucracy, fewer rules, less attention to process than to achievement, and in general, more of a willingness to change, grow and adapt.

Conversely, probably many of us would describe the colleges and universities in which we work in quite different ways: a fairly rigid hierarchy, a thick Personnel Manual full of do's and don'ts, a firmly entrenched salary and title structure which tends to reward longevity as much as anything else, a well-defined chain of command, and so on. Insofar as an institution that fits this description cannot take advantage of innovation, we maintain that it's also going to have some considerable trouble in making good, effective use of technology.

One other thing we should make clear. It is unrealistic to think that higher education, having been around since about the fourteenth century, is somehow going to become something that looks like a Silicon Valley start-up, and everyone's going to walk around in sandals and tee-shirts and work strange hours and give up their titles in favor of participating in quality circles, and so on. But some changes can be made, and especially if there are one or two key people on each campus who will act as change agents.

The suggestions that we are going to propose assume that someone on campus is going to be the change agent. It would be nice to think that someone is the campus's ranking computer person, whether that be the computer center director, or the Vice President for Integrated Information Systems Resource Delivery Services and Everything Wonderful. Of course, if all else fails, the President will do in a pinch. Even though we all know that it won't always be the computer person who initiates change, the computer people do have a special responsibility to their institutions in this regard, mainly because of their involvement with, and their knowledge of, the most dynamic subject matter that has ever been. Computer people have had the opportunities to learn by now how to handle and how to take advantage of change, and they can serve in this regard as the leaders and models for the rest of the campus.

Suggestion #1: Decentralize

Of course, the moves toward decentralizing computing have been underway for some time. But we're talking here about more than just allowing some end users to have microcomputers. We're talking really about decentralizing the capacity for responsible computing. This means access to the mainframe data bases; it means education and training in all of the things computer people have learned over the years about protecting the investment in their work (structure, documentation, backups, etc.); it means responsibility for making some big decisions about computing on campus as a whole. Most important, it means that computer people have to trust that the end users know what they're doing, despite some apparent evidence to the contrary.

By decentralizing, some of the rigidity inherent in the typical hierarchical, segmented organization will begin to dissipate, as information, knowledge and resources are shared across organizational boundaries.

Suggestion #2: Ten Important People

Pick a number of influential people on campus that seem to be fairly accessible, reasonable, friendly, intelligent, and willing to try new things. Befriend them. Make them allies for your point of view about where computing on campus ought to be heading. Convince them of how they can use technology to further their own ends, whether those ends be educational, political or simply recreational. Have lunch with them often. Make sure they hear about every good thing that happens in the computer center, and when there are problems, make sure they hear your version of what happened. Once you have won their trust as a fellow human being, begin to suggest that they try some of your ideas. Make sure they get tons and tons of support for anything they want to do even remotely connected with computing. If they want to buy their eleven-year-old daughter a computer for Christmas, make sure they go to the right store, get the best advice, obtain any available discount, and receive a personalized Christmas card from the dealer. After a while, these people will begin to influence others, and a chain of information will begin to be constructed throughout the campus which will thread through and around the formal organizational lines.

Suggestion #3: The Right Committee Structure

There are committees and there are committees. One of the characteristics of a very rigid institution is a whole bunch of standing committees, most with no real power or authority, but serving simply a means for the committee members to garner status and prestige, along with presenting an illusion of collegiality.

There are ways, however, to make committees into something really useful and innovative, and some institutions have already done this. The right committee structure might look something like this: At the top is a high-level group made up of representatives from a cross-section of campus groups, which advises the President on strategic campus technology matters and has the authority to make decisions. This may be called a steering committee, an advisory committee, or it may be a subcommittee of the President's Cabinet or some similar group. However, this is not a committee that one gets put on by virtue of one's position, or length of service, or as a reward for good behavior on some other committee. It is made up of people, including the computer people, who are smart and have vision and have the institution's best interests at heart. The key lies in its authority to act without permission from any single vice president. This is the group who will decide how computing will further the goals of the institution, how computing priorities will be set, how resources will be obtained, and other strategic issues.

The next level down will be one or more advisory/user groups for the computer center itself. This is a fine opportunity to co-opt some of the computer center's loudest critics, by making them committee members and actually giving them some responsibility for deciding how things should be done. Having to negotiate with one's colleagues is not the same thing as commanding the computer center to shape up.

Both of these types of committees, if done well, will serve a very important communications purpose in having different kinds of people, invested with some real authority and responsibility, making real decisions across traditional organizational boundaries.

Suggestion #4: Planning a Direction

One of the traps many of us have fallen into in the past several years is in the area of planning. It's a trap because planning is so often done for the wrong reasons, in the wrong environment, and for the wrong people.

What too often happens with the results of all of those long and difficult hours spent in constructing and writing the plans is either one of two alternatives. The first occurs after all of the hearty applause at the initial presentation; everyone's copy of the plan gets put up on a very high shelf somewhere, never to be looked at again until the next consultant or a brand new vice president comes along and says that there ought to be some strategic planning going on around here. The other alternative is at the other end: blind obedience to the plan regardless of changes in circumstances, key players, technology or resources. In both of these cases, the planning effort has become a defensive posture, and can do a great deal to stifle creative changes that might really be beneficial to the institution.

Planning done in the right environment and in the right way, however, can be a key factor in helping the institution position itself with regard to taking advantage of technology. The most important part of the planning effort is the formulation of some kind of statement of direction, rather than specifying endless details about the next x number of years. An articulation of direction, rather than details, allows for some organizational flexibility and keeps the institution much more able to respond in a positive way toward changes.

Suggestion #5: The Chief Integrator

Many of you are familiar with the growing tendency for our institutions to create and staff a "computer czar" position, and it's a topic we can continue to discuss in other forums. But regardless of your feelings about this trend, there is one aspect of it which is critically important, and that is in the person's role as an integrator between the computer people and the rest of the institution. It can't be emphasized enough that the person in charge of computing must know as much about the institution and about higher education in general as he or she knows about technology. That person should know about the promotion and tenure process, about the Board of Trustees, about the current controversy surrounding whether colleges and universities have to account in their financial records for depreciation of assets, about what the accreditation process looks like, about what the educational goals of the institution are, and so on. In other words, the chief computer person has to be as much an institutional person as a computer person, and must make sure that communications from and to the computer people, and communications from and to the rest of the institution are clear and free-flowing. That person's reading list should be as likely to include The Chronicle of Higher Education and Change Magazine as it does Computerworld and PC Week.

In being the Chief Integrator, this person serves as perhaps the most important catalyst in helping the institution get away from rigid compartmentalization, and the limitations inherent in having the people in each department know only about what goes on in their own territories.

Suggestion #6: Hands-on

One of the most important factors in helping the people at the top to relate to technology is proximity. Talking about something terrific is not the same as giving someone the opportunity, in private, to see how good it really is. It is unrealistic to expect that all of the people who can benefit from technology will ask for it; they may not know enough to ask, they may think they don't have enough time, or they may not want to put themselves into a new learning situation. There are a whole host of reasons that many of our presidents and vice presidents resist actually being in the same office with a computer. But we have good reason to suspect that once over the initial hurdles, it is very likely that these people will become, if not fans exactly, at least more tolerant of technology, be more understanding and realistic in their approach to computers, and be better able to serve as leaders for the rest of the institution.

There are some ways to promote hands-on, although they do mostly involve at least a bit of subterfuge, and are often met with limited success. Fortunately, however, this may be one of the problems that eventually takes care of itself, as the people entering the top levels of our institutions increasingly bring with them either the experience or the desire for hands-on. In the meantime, even the slightest hint from the top of wanting hands-on should be enthusiastically encouraged.

Suggestion #7: Budget

Most colleges and universities follow a highly structured two-year budget process. The first year is spent reviewing program needs - both continuing and new - and working through a cumbersome approval process starting with the faculty member or administrative head and culminating with the trustees. Year two is the spending year - a time to maintain successful old programs and finally to act on new ideas generated as much as two years prior. We believe this budgeting system encourages the status quo while demotivating creative faculty and administrators. Good ideas need immediate attention. Resources should be readily available to help administrators capture the energy and vitality so often stimulated with creative thinking. Thus, the question is how to run an orderly budget process while making resources available to facilitate institutional responsiveness to new ideas of merit.

Rather than allocate a university's entire budget for specific programs - even specific line items - we suggest holding out a pool of funds that are undefined or unassigned. The definition for these funds should be allowed to take shape as the year progresses and, more importantly, as ideas and opportunities emerge. The responsibility for allocating these funds could be that of academic deans or a committee with the composition and power akin to our suggestion in #3, above. In this case, process is not as important as responsiveness; making funds immediately available to support innovative thinking is the key.

For the real risk takers, we suggest making limited funds available before a well-formed idea even emerges. For example, academic deans could award funds to individual faculty with only one stipulation: use it for a totally new project. There is also the possibility here to encourage broader, more synergistic thinking. The dean, for example, might require that this new project be cross-disciplinary. Reversing the traditional sequence of idea, review and funding, to funding first, idea next (skipping the review), should increase the pool of innovative thinking institution-wide. Necessity may be the mother of invention, but a little cash up front never hurt either.

Suggestion #8: Space

We thought ending our list of suggestions with one that is highly speculative, if not amorphous in nature, would promote a little creative thinking here today. That is another way of saying we have a suggestion, but we aren't exactly sure how it works. The subject is space, and how it influences behavior - in itself a topic for another full paper if not a dissertation.

While everyone in this room would agree that quality and kind of space is a major determinant of behavior, we probably would have a difficult time agreeing on exactly how. Some research has been done on the subject; however, the field is far from being classified as a quantifiable science. We mention it today because of our strong belief that the structuring of space is a very powerful tool in stimulating innovative thinking. And by stimulating innovative thinking, we hope to bring our institutions into greater harmony with technology.

Remaining safely general, we suggest spaces with generous amounts of natural light, accented with soft, warm, artificial light of the incandescent type. Rooms should have an open feeling with little segmentation - fewer walls with greater visual access to other members of the community. Ceilings should be high but in proportion and fresh air should be in ample supply and circulated continually. If that sounds like an environment your machines live in, but not you, don't feel alone. We believe that the emphasis on providing the "proper machine environment" has drained attention away from creating positive human environments -- ones that stimulate rather than rigidify. Computer professionals are often placed in the basement without even minimal amenities such as refreshed, circulating air. Ask yourselves one simple question: Does my machine live better than me?

Recapitulation

Implied in the theme of this year's conference is the question, how can we improve on our performance to date? How can we increase the impact of technology on education, bringing it more in line with what we should expect from a massive allocation of resources like we have seen over the last several years? As subsets of that inquiry, we have also asked the following questions: Why is there a lack of integration between institutional goals and technological goals? Why is there abundant defensive behavior on the part of executives and computer people in dealing with technology? And why, in general, is there a lack of executive involvement with technology? Understanding these questions as symptomatic of a common problem, we have sought to create a cognitive framework to aid with our analysis. We call our framework "the life cycle mismatch" - higher education and technology out of phase on critical life cycle issues. In an attempt to promote greater harmony between education and technology we have offered eight suggestions which can encourage our institutions, or more appropriately, the people in them, to behave in ways more consistent with early life cycles. Creating the proper institutional environment for technology to grow will promote, we believe, the best leveraging, if not the flourishing, of technology.

PANEL DISCUSSION SUMMARY

APPROACHES TO THE REPLACEMENT OF MAJOR APPLICATIONS SYSTEMS

Moderator: Richard Howard
Director of Institutional Research
North Carolina State University

A. L. LeDuc
Miami-Dade Community College

E. Michael Staman
Vice President, Sales and Marketing
New Jersey Educational Computer Network, Inc.

Charles R. Thomas
Vice President
Information Associates

Deciding to phase out a major applications system is the first of a series of decisions which can result in either significantly improved functioning and service (best case) or the classical "unmitigated disaster" (worst case). The actual result is a function of many decisions along the way.

One of the earliest decisions in the process, possibly the most important, and surely among the most controversial, is whether to develop the new application in-house or to seek outside help through either a software house or an independent third party. Each option has advantages and disadvantages; improperly managed, all will become a labyrinthine and uncertain adventure. Nowhere are failures more painful and visible in computing activities than at the end of a costly, highly- publicized, multiple-year development project which fails to meet user expectations, design specifications, or some combination of the two.

In this session, the panel discussed the relative merits of in-house development (Al LaDuc) versus purchasing and adapting a system to meet the needs of the campus (Chuck Thomas). In each case the advantages and disadvantages were presented with an analysis of the critical decisions which must be made for each course of action. Mike Staman then discussed the merits of working with an independent third party in deciding whether and how to replace major applications systems, and the processes of designing, developing or acquiring, and implementing such systems.

The bottom line after all discussion, was that the decision to purchase an outside system or to develop one in-house should be made in light of the institution's existing systems and the implications for the new system's integration with them. In either case an objective third party can often provide an unbiased analysis of needs and the expertise, both in the "build vs. buy" decision and in the management of implementing a new application.

PANEL DISCUSSION SUMMARY

KEEPING USERS FRIENDLY

Richard D. Howard
Director, Institutional Research
North Carolina State University

Mary M. Sapp
Director, Planning and Institutional Research
University of Miami

Deborah J. Teeter
Director, Institutional Research and Planning
University of Kansas

Gerald W. McLaughlin
Associate Director
Institutional Research and Planning Analysis
Virginia Tech

One of the traditional wisdoms of the information age is that end-user support should be user friendly. While this belief has been applied traditionally to hardware and software, it is also appropriate for administrative policies, procedures, and organizational structures. In this panel, the data management philosophies at three large research universities were presented. Issues of data access, people, and user training were discussed in light of each philosophy. Reguardless of data management environment, the user needs are similar; they want timely information to support decision making.

The participants in the panel all have responsibility for the institutional research function on their campus. Traditionally, this function has been the interface between those responsible for data processing and those who were in decision making and policy development roles. It is from this perspective that the panel addressed the above issues within the data management structure and philosophy at their institution.

Deb Teeter discussed the mature centralized structure in which administrative data control is implemented in one central office which establishes policies and procedures for the campus.

Gerry McLaughlin explained the issues raised in a decentralized information structure where no central agency performs the traditional data administration functions.

Mary Sapp provided insight into the situation where an institution is in a dynamic transition with many new systems in the formative stages. In this fluid phase, many responsibilities are being reassigned as the process moves from batch to on-line.

Regardless of the institution's data management philosophy, these issues must be addressed within the context of the present environment and a strong sense of what you want it to be in the next five to ten years. It was apparent that all institutions represented on the panel are dealing with the effects of increased computer literacy across their campuses and the demands for direct access to administrative data that has resulted.

INTEGRATED TELECOMMUNICATIONS PLANNING - DISTRIBUTED MANAGEMENT

Phyllis A. Sholtys
Northern Kentucky University
Highland Heights
Kentucky

Planning and management responsibilities for data, voice, and video communications have traditionally fallen under more than one administrator and often cross organizational lines as well. The underlying technologies, however, have become so interwoven that effective planning for one area now requires consideration of all. Universities need a mechanism to coordinate and consolidate planning for campus data, voice and video communication systems.

This paper identifies one means of developing an integrated planning process without disrupting established management and reporting channels. Development of a consolidated telecommunications plan for data, voice, and video is discussed, starting with development of a planning structure that successfully crosses organizational boundaries, to identification of campus needs and development of strategic and operational plans to meet these needs. The paper focuses on what was learned through one institution's experience in developing the plan and how they can help others.

The Setting

Founded in 1968, Northern Kentucky University is the youngest member of Kentucky's public university system. Located on a dual campus of 289 acres and 19 buildings, the University serves a population of over 9,000 students, most of whom commute from within the Northern Kentucky region and the greater Cincinnati (Ohio) metropolitan area. NKU is a multi-purpose institution, offering degrees in arts and sciences, business, professional studies and law, combined with a large continuing education-outreach program.

In 1981 the University replaced an 800 line Centrex system with a campus-owned 1200 line analog telephone switch. One-way closed circuit television (CCTV) was available in 4 of the 19 campus buildings. Instructional and research computing relied on a DEC PDP 11/60 minicomputer (since replaced by a VAX 11/785), while administrative users were supported by an IBM 4331 (upgraded to an IBM 4381). Approximately 50 microcomputers were in use, primarily in instructional departments. Access to the PDP was limited to 22 dial up ports. IBM connectivity was available only to office users within ready coax distance of the mainframe.

By 1984, the university's voice, data and video delivery services were suffering from campus growing pains, technological change and rising expectations. With the addition of two new buildings and general campus expansion, the telephone switch was saturated and plans were underway for its expansion or replacement. During the same period, a rapid increase in the number of stand-alone microcomputers put substantial computing capability into the hands of end users who were beginning to demand access to the University's central computers. Campus video services also needed expansion to other buildings, an upgrade to two way video was under consideration, and there was growing recognition that a satellite receiving station could significantly boost educational programming options.

In addition to the growing pains described above, there was pressure on the voice, data and video departments to expand services at the branch campus some eight miles from the main Highland Heights facility. Originally used as the first site for the university, the branch campus later housed the law school, and most recently become the focus for continuing education and other non-traditional activities. The only communication links with the main campus were 30 leased, voice-grade telephone lines. Additional voice lines were urgently needed to support the 40 people and eight offices housed there. Moreover, the branch campus was devoid of CCTV capabilities and also lacked direct access to the mainframe computer and its administrative support services.

Planning Environment

Each university division maintained separate planning and advisory groups and coordination of division plans occurred during the budget process. Within divisions, most planning took place at the department level. An exception to the segregated planning process occurred in the area of computing and information services. An Information Management Policy Committee, made up of the major division heads and executive staff officers, addressed policy issues and established priorities for computing-related activities. However, the service units responsible for voice, data and video communications reported to different areas of the university and the unit managers were attempting to address planning and expansion issues from within these separate organizational structures. (See figure

1.) Video services is the bailiwick of the media services director who reports to the associate provost. Telephone services reported through facilities management to the vice president for administrative affairs. The director of computer services (supporting both academic and administrative computing and data communications) reports through an assistant vice president for information management within the administrative affairs division.

Moreover, activities of other planners directly impact the service load of the three units above. For example, a newly created position of director of academic computing (reporting to the associate provost) is responsible for establishing priorities for instructional and research computing. The campus library (also reporting to the associate provost) added still another dimension to the planning environment with goals for full scale automation of library functions, including access to an on-line card catalog from campus offices and dorm rooms.

Despite the structured bureaucracy, informal contacts were maintained among the individuals with functional responsibility for voice, data and video services. Also, the library director discussed library automation plans with Information Management personnel. Casual meetings revealed that all of these offices shared concerns about the need for expanded services for the two campuses and about the rapid technological convergence that was occurring among delivery systems for voice, data and video.

Informal Team Approach

During the 1984-85 academic year, the Assistant Vice President held several informal meetings with the directors of computer services, voice communications, and facilities planning to discuss the growing voice and data communication needs of the campus and implications for an anticipated telephone expansion during the next biennium. Decisions would be needed concerning the appropriate role for the telephone switch in supporting data communication for the campus. However, it was evident to the participants that a longer term direction should be established for both voice and data communications. The meetings continued and the core group asked the director of academic computing to join in an effort to define and address the planning issues.

The participants shared a growing conviction that the campus required a robust communication system to enable maximum utilization of the university's expanding storehouse of computer equipment, databases and library resources; provide the capability for rapid information transfer; and enhance NKU's ability to deliver instruction to an increasingly diverse and dispersed student population. The group recognized the problem and was eager to address the planning issues, but it lacked recognition as a formal campus committee and had no official charge.

Seeking official status for the group, the Assistant Vice President submitted a proposal to the Vice President for Administration to establish a formal planning committee. The proposal emphasized the need to ignore organizational boundaries and integrate planning for communication systems at the University. Committee membership would consist of officers with functional responsibility for implementing and delivering voice, data and video services, and the directors of academic computing and the library. Since most of the recommended members had also participated in the informal group, the history of these earlier meetings provided evidence that a cross-organizational committee could work together.

During the summer (1985), the proposal was approved by the vice president and endorsed by the Provost and the chief student affairs officer. The Assistant Vice President was named chairperson and the Telecommunications Planning Committee's report would be submitted to the Information Management Policy Committee. The informal team approach had successfully bridged organizational boundaries and won support as the official planning group for campus networks!

Planning process

The major goals for the planning effort were to identify the telecommunications environment needed for the 1990's and beyond, and to define a stable network infrastructure into which modular components can be connected.

The first official task was determining a planning strategy to meet the committee charge. We approached the planning effort in five phases or steps:

1. Define the problem, establish boundaries and identify constraints.
2. Assess the current environment.
3. Define current and future telecommunications needs.
4. Specify requirements and standards.
5. Develop a network implementation plan.

One of the first challenges was the need for committee members to develop a broader understanding of voice, data and video delivery systems. Each officer with functional responsibility for communications had solid technical strength in one technology but only cursory knowledge of the other two. Other members lacked technical background, but brought an essential user perspective to the committee. For the committee to effectively accomplish its task, we all had to know enough about the three technologies so we could ask the right questions. Accordingly, committee members reviewed a substantial body of literature, attended general information presentations by major vendors, participated in regional communications and computing conferences, attended communication workshops, and monitored network plans and implementation progress at two regional universities. By the time the planning committee survived the intense orientation process, a true working team had emerged.

Two planning issues quickly surfaced. The first was related to the basic charge, which was to define a stable network infrastructure that would allow incremental expansion of campus networks. To achieve the necessary compatibility, transportability and connectivity goals the campus would need to adopt and maintain clearly defined standards. Although this presented few problems for voice and video, since these technologies adhere to established standards, data communication is chaotic. With NKU's multi-vendor computing environment, we faced the challenge of linking incompatible architectures and conflicting operating systems and communication protocols. Moreover, in the face of rapid changes occurring in the connectivity arena, the committee was concerned about the feasibility of locking the campus into a rigid data network scheme.

The second issue related to the need for a communications consultant. The committee was convinced that an outside consultant would be an essential resource for the Committee, but was uncertain about the timing for the consultant's participation, and how to locate someone with sufficient expertise in the three technologies. Ultimately, we decided that it was essential for the University to define where it wanted to go before calling on a consultant to help develop a plan to get there. Accordingly, the committee opted to conduct a needs analysis prior to seeking a consultant.

The Committee prepared an inventory of communication and computing facilities and conducted an extensive review of campus needs. A draft needs analysis report was prepared and disseminated for campus review. When the draft "hit the streets," several open meetings were held to discuss the document and respond to any questions. As an additional step in the assessment process, a campus survey was conducted to obtain detailed information on perceived communications needs and their relative importance. Based upon survey responses and interaction with the campus community, a final needs assessment report was prepared.

The study quickly verified that the University had exhausted the resources of its current communications systems. NKU's most urgent need is for expanded telephone service as well as communication networks to provide access to already existing computer and video resources. Plans to automate library records and expand administrative systems will compound the access demands. At the same time that voice and data communication needs are multiplying, we need to extend instructional video capabilities throughout the two campuses and to other sites.

While the campus was reviewing and responding to the preliminary needs analysis, the Committee focused its energies on defining needs in functional terms of telecast, voice and data loads; acceptable transmission speeds; wiring topologies; and wiring media. Preliminary standards were under discussion. Because the cost of expanding the analog voice switch (an obsolete model) was nearly as costly as replacing it with a larger digital switch, it was clear that the university should move to digital technology. However, a digital switch was not viewed as the appropriate vehicle to support the bulk of the data communication traffic. Future usage patterns would include heavy data transfer and concurrent use of computer resources, thus pointing to the need for a high speed communication backbone for the campus.

Opportunities and Constraints

The Telecommunications Planning Committee soon faced an additional challenge. During the state's biennial budget process, NKU received authorization and funding to construct an applied science and technology center (AS & T), and for a telephone upgrade. Because the AS & T center would house student computing labs and a number of technology-intensive academic departments, the construction budget included an extra allowance for installation of communication networks for the building.

From the perspective of the Telecommunications Committee, the construction project provided both opportunities and constraints. The networks slated for the new building focused attention on the Committee's work and provided an immediate application, albeit a rather large "pilot" project. Also, the first link of a campus backbone network would be installed to connect existing services to the new building. However, the advent of the building also vastly accelerated the planning schedule! After the architectural and engineering firms were selected by the state, it was essential that the University define specific requirements -- including those for communication networks -- in a timely fashion. We had less than three months to complete our initial specifications, as far as AS & T center was concerned.

Under these circumstances, extensive deliberations were a luxury we could no longer afford. We embarked on a crash project to define appropriate standards and identify viable options available in the marketplace. Fortunately, the Committee had already articulated draft communication standards, made preliminary determinations about the feasibility of integrating voice data and video delivery systems, and developed a "concept" schematic showing typical building wiring and future campus interfaces (figure 2).

When the AS & T project got under way, the committee was fast approaching the stage where a consultant was needed. To our initial delight and later frustration, we found that the engineering firm would obtain consultant services as part of the building and telephone contracts.

The engineering group handled the building's video design with their own personnel, but subcontracted with separate telephone and data communication consultants the design of the other two systems. The consultants' roles bore little resemblance to initial committee expectations. We had envisioned the active participation of a technological gadfly who would test the committee's assumptions, suggest viable alternatives and refine the committee's ideas. Instead, each consultant worked independently of the other to turn University specifications into a structured bid document for his respective area of responsibility. What was missing from the deliberations was a broad perspective of video, voice and data.

Although there was initial disappointment that neither consultant provided any new conceptual insights, the Committee was reassured to find that our preliminary plans appeared credible to the outside experts. Neither consultant indicated any problem in designing installations to meet our specifications.

In retrospect, the greatest constraints associated with the construction projects were related to time and funding issues. In regard to time, it was more than a little disconcerting to the Committee to realize that the University was implementing specifications developed as part of a plan that had yet to be submitted for approval! The funding constraints were frustrating for, under Kentucky regulations, authorized projects had to stay within the state-approved budget and the campus could not supplement the project budgets from other fund sources. Accordingly, many compromises were required to keep costs in line. For example, the budget for the telephone project was too small to fund a switch sufficient to meet long-term campus needs. Rather than lock the campus in with an undersized switch, the university compromised by specifying installation of a large switch that would be delivered with only 1400 installed ports. Thus, we could keep the project within guidelines and later purchase the additional ports from other funds.

Despite their misgivings about making decisions without the lengthy deliberations typical to an academic institution, Committee members were delighted that the first modules in the development of a networked campus would soon be put in place. Although some of the components and standards advocated by the Telecommunications Planning Committee had received defacto campus approval within the context of the building and telephone projects, the Committee wondered what reception awaited the full report. We soon found out.

The Plan

The telecommunication plan advocated development of comprehensive systems of voice, data and video networks to be accessible throughout the campus. The development plan was based upon four fundamental strategies:

- o Because of the university-wide scope and high costs, an incremental implementation of modular projects will be needed.
- o To achieve compatibility, transportability and connectivity goals for campus networks, standards must be defined, adopted by the institution, and maintained for all projects.
- o Centralized university funding should be provided for backbone networks between buildings and for building distribution systems.
- o To promote user commitment and wise stewardship of University funds, departmental networks and connection to intra-building systems should be the responsibility of the offices and units wishing to use the communication system.

In all, ten modular projects were defined for implementation over a five-year period. These included a new digital telephone switch, a high speed backbone network, video satellite uplink and downlink, and several modules to provide building distribution systems. Completion of the projects will not completely wire the campus, but the major delivery systems will be in place. Departmental connection to intra and inter-building systems will be financially attainable for those who seek access.

The Committee report received wide review and discussion on campus. There was general agreement with the need for and scope of the projects recommended, although some areas of the university believe the proposed implementation schedule is too slow and others feel it is too aggressive. The relative priority assigned to individual modules may well change as various groups lobby to have favored projects move up in the ranking. The plan is officially still under final review by the Information Management Policy Committee and modifications in project sequence and timeframe are likely. However, there has been consensus on the design strategies advocated by the committee, (i.e., implement a series of modular projects, and adopt and enforce the use of standards).

Even while the plan is being refined, there are mounting pressures to get on with implementation. Departments want to begin installing departmental LANs with the assurance that they can eventually be connected to a high speed backbone network as it becomes available. In this context, the Policy committee has charged the planning group with identifying specific LANs that meet defined standards. Funding approaches for the major modules are under discussion, and the campus atmosphere is one of "lets get on with it!"

Implications

At Northern Kentucky University the operating units that support voice, data and video communication were distributed throughout the organization. The planning approach provided a way of integrating the planning process without disrupting established management and reporting channels. By forming a partnership of multiple service units and major users, we had a planning team that also had campus-wide credibility. The experience has led to some conclusions and recommendations for others who wish to embark on a similar planning process.

1. Focus on a shared interest. The centrality of the communication planning issue served to unite planners from throughout the organization. Because the

committee members were directly responsible for delivery of services, or were major users of the services, group motivation was high.

2. You need a facilitator. This requires an individual who is willing to go beyond stated organizational jurisdiction, to solve problems.

3. Try the informal team approach. Low key, unofficial meetings and an area of mutual interest can overcome organizational and political barriers. Once the group demonstrates its commitment to coordinated planning, convincing the rest of the organization is comparatively easy.

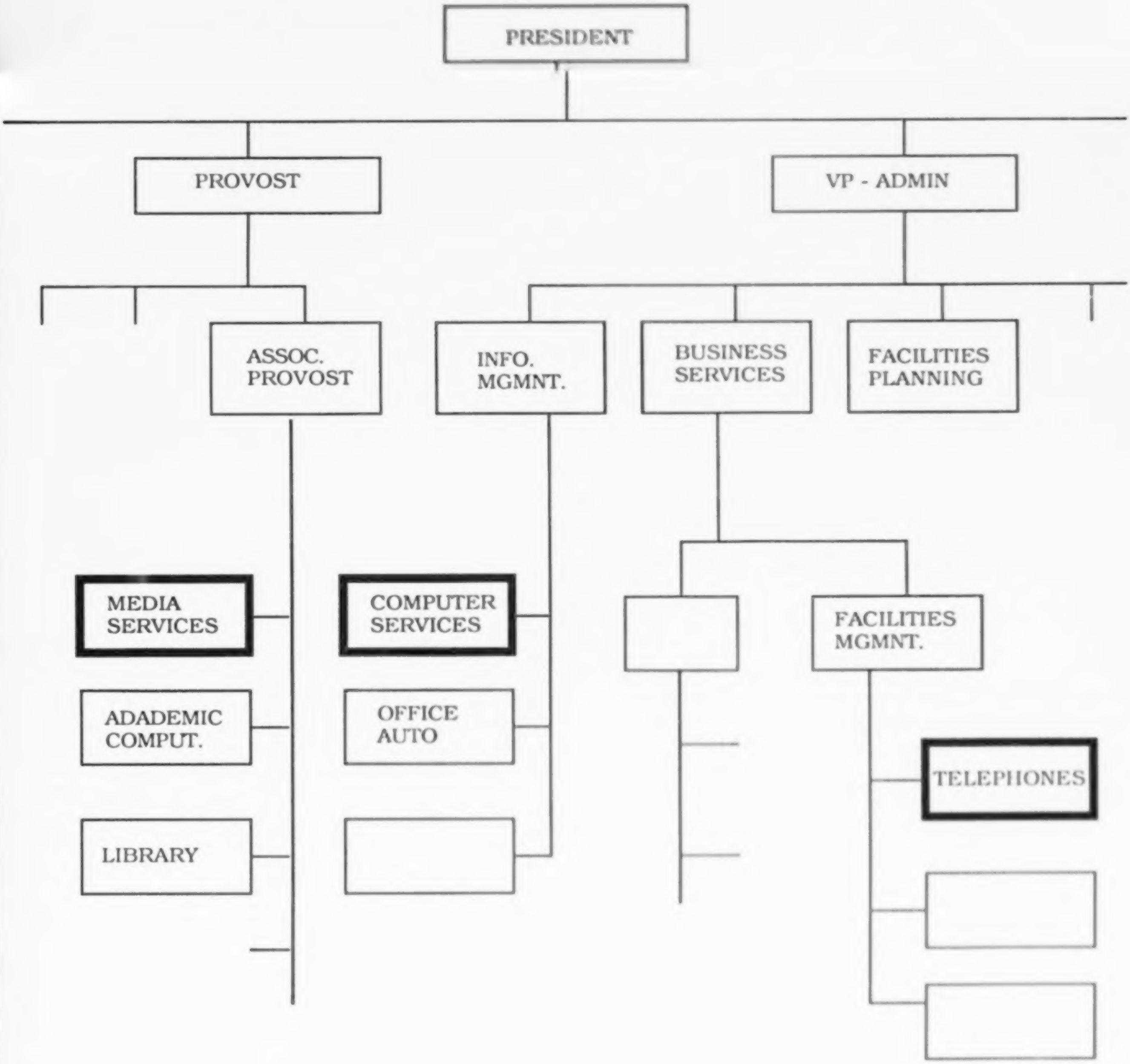
4. Bridge the technical specialties. It is essential to spend some time in developing a broad understanding and appreciation for each of the technologies involved. The initial learning activities undertaken by the committee members provided helpful information for all, and the shared learning experience helped develop a cohesive team atmosphere.

5. Set some ground rules. Members of the planning group must understand that the committee role is not to pass judgement on established goals of individual units or areas of the university, but it is to focus on developing a combined plan to achieve defined goals.

Conclusions

Information technologies have become a basic campus resource and their development impacts the total institution. Moreover, the underlying technologies have become so interwoven that to plan for one requires consideration of all and it is increasingly important that coordinated planning mechanisms be employed.

For many institutions, organizational restructuring has created a framework to facilitate coordinated planning for technology. Even within these organizations, effort is still needed to bridge technical specialties and develop cohesive planning groups. In institutions with distributed management structures, the challenge is even greater for you also need to bridge organizational and political barriers. Whatever organizational model is in place, it is essential to bring institutional vision to the planning task. Although there is no perfect solution that will work for all institutions, building a planning team unified by mutual responsibilities and interests is a strategy to consider.

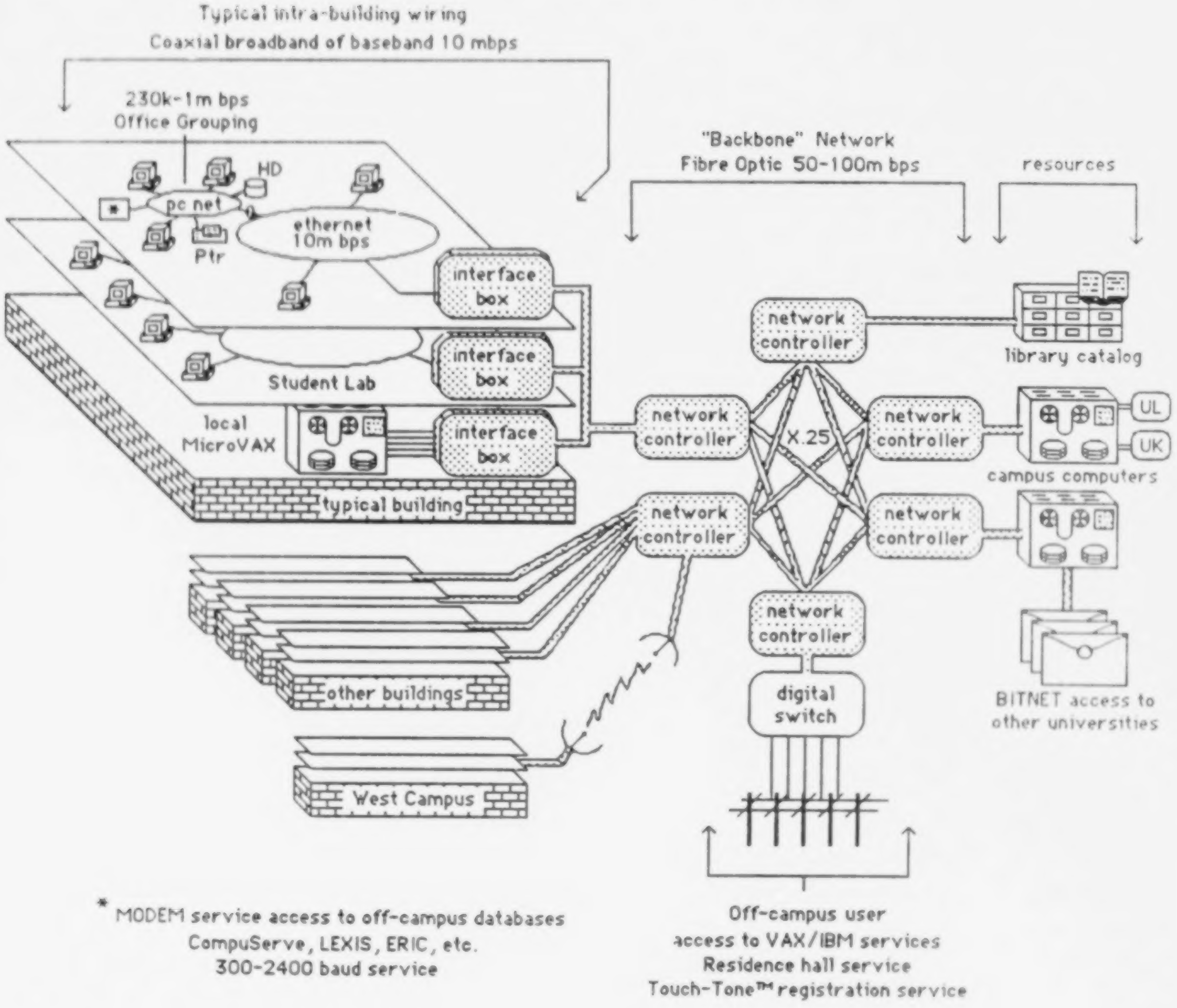

PRESIDENT
PROVOST
VP - ADMIN
ASSOC. PROVOST
INFO. MGMNT.
BUSINESS SERVICES
FACILITIES PLANNING
MEDIA SERVICES
COMPUTER SERVICES
FACILITIES MGMNT.
ADADEMIC COMPUT.
OFFICE AUTO
TELEPHONES
LIBRARY

COMMUNICATIONS MANAGEMENT AT NKU

Figure 2.

NKU Data Network

Concept Diagram


Typical intra-building wiring
Coaxial broadband of baseband 10 mbps
230k-1m bps
Office Grouping
HD
pc net
Ptr
ethernet
10m bps
interface box
Student Lab
interface box
local MicroVAX
interface box
typical building
"Backbone" Network
Fibre Optic 50-100m bps
resources
network controller
library catalog
network controller
X.25
network controller
UL
UK
campus computers
network controller
network controller
BITNET access to other universities
network controller
digital switch
other buildings
West Campus
* MODEM service access to off-campus databases
CompuServe, LEXIS, ERIC, etc.
300-2400 baud service
Off-campus user
access to VAX/IBM services
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Template from U of Pittsburg

HIDDEN IMPACTS OF ON-LINE SYSTEMS

A presentation to

CAUSE '87

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by

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ABSTRACT

Many colleges and universities are discovering that new on-line administrative computer systems, while initially very attractive, require a great deal more time and money than originally expected. This paper examines on-line systems, their advantages and disadvantages, and what surprises, or "hidden impacts" might be in store for the unsuspecting institution. Finally, advice is given on how to avoid the hidden impacts through additional considerations in the project management.

"Hidden Impacts of On-Line Systems"

CAUSE '87, Jeffrey W. Noyes

Introduction

The current trend in the use of computer technology to support the administration of colleges and universities in the United States is moving toward the use of distributed or "on-line" computer systems, that is a computer system in which a central, composite data base is accessed and controlled from a far reaching network of workstations located in a variety of departmental, or user, offices. This trend is supported by several factors, both from the computer industry and from within the higher education community itself.

Continuing advances in electronic technology drive the costs of computer equipment ever downward, while at the same time increasing the power and capabilities of that equipment at a fantastic rate. In addition, major functional innovations, such as word processing, networking, spreadsheets, and electronic mail, have come about during the past five or ten years that allow a complete new approach to using computer technology for administrative or business functions. The marketing forces of the computer industry, ever trying to increase - or maintain - sales, bombard us with ads claiming that we cannot live without the latest PC, network, mainframe computer, or other new piece of technology.

The past decade has seen things change within the higher education community as well. The numbers of traditional age students are decreasing dramatically, the tightening national economy is making funding more difficult by restricting government funding and changing tax incentives for private fund raising, and the average age of our faculty is becoming a burden. Serious competition has arrived at the hallowed halls. In response to these factors, colleges and universities have begun to adopt management techniques more commonly used by business. These techniques of budgeting, accounting, management reporting and performing self-analysis require data processing capabilities beyond that possessed by many colleges and universities in the recent past.

All of these factors are bringing a large number of colleges and universities, including a growing number of smaller colleges, to make the commitment to "on-line" systems. These systems, as claimed by their vendors, provide for instant access to all information from every desk, guarantee that all information is up-to-date minute by minute, and that any type or style of report imaginable may be created by any member of the office staff. As we shall see, there is truth in all these claims, but a great amount of false expectation may be built if the proper planning is not done.

The most common error, an error of omission, made in the installation of on-line systems is failing to include all aspects of the institution in the planning process. While the system changes dramatically, usually the planning process does not. That is, planning takes place in the same fashion that it always has, mainly involving the DP staff and some representation from major user offices such as accounting, payroll, and registrar. What is generally not realized is that major changes will take place in all user offices, and that those aspects of change must also be taken into consideration. These are the "hidden impacts" to watch out for.

In the end, we learn that on-line systems do indeed provide most of the benefits claimed, and that they are certainly worth the investments required in money and time to purchase and install. We also learn, however, that they do cost more than might initially be imagined and that they significantly change the use and management of information in offices throughout the institution.

Background

To facilitate a common understanding for discussion, it will be useful to make the following definition of the term "on-line systems". As mentioned in the introduction, "on-line systems" are generally computer hardware and software systems used to support the administration of the organization. "On-line" refers to the utilization of a great many work-stations or terminals located throughout the organization all connected to a common, usually central, computer complex. In addition, "on-line" usually refers to the fact that all of the data is stored on active, immediately accessible disk drives rather than on secondary data storage devices such as magnetic tape or removable disk packs. "Data base" software is used to provide for centralized data files that are accessible from the work-stations, and data files that are coordinated or "integrated" with each other. For example, an address change must be made only once in the system, but will be recognized by the accounting, payroll and personnel systems. Finally, these systems are usually supplied with a modern, or "fourth generation", retrieval language that allows end-users to directly produce special reports at will. There is obviously a great deal more to such systems, such as networks, application and operating system software, and so on, but these items describe their main features.

It will also serve as interesting background to note the major factors that have placed the higher education community in the position of dealing with the issues surrounding the installation of "on-line" systems. Why are we here?

A great deal of the change in computer systems is brought about by the underlying changes in the technology or hardware that make up those systems. The electronics and computer industries have brought us cheaper and faster hardware in the form of the computers and related peripheral equipment consistently over the past several decades, and there is certainly no reason to expect that trend to change in the near future.

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In addition, communications networks have become so widespread and so fast that it is now possible to transfer great amounts of information over distances both great and small, very quickly, accurately and at little cost. Finally, the improvements in hardware speed and size have brought about a revolutionary new product: the personal computer, or PC. Substantial computing power is now available on the desk of the individual user at affordable prices.

Substantial advances have been made in software as well. The programs that allow us to harness and utilize the power of the computer have become more capable and sophisticated, and at the same time, easier to learn and use. New concepts in software over the last few decades that have led to "on-line systems" include time sharing (interaction with the computer through a terminal or work-station), data bases (structured organization of data files), fourth-generation languages (4 GL's) for easier program development and data retrieval, and perhaps most importantly, microcomputer concepts such as spreadsheets and word processing.

These factors give us the tools.

The next set of major factors involve the market place. Computer manufacturers need to sell their newly developed (or soon to be developed) products to stay in business, so they develop a variety of marketing strategies. In addition to advertising, they create new application products, form user groups, conduct joint development projects with users, and continually stress the improvements of new products and the benefits to those of us fortunate enough to purchase them. As a result, we've heard a great deal about "instant access", "end-user computing", and the advantages of "user control" and "4 GL's."

These factors give us the awareness.

Finally, for any change to be widespread, there must be a need. Today there is certainly a need for improved management techniques in higher education. The intense competition brought about by fewer students and limited funds is forcing colleges and universities to be more aware than ever before of the real costs of providing education, of a wider range of revenue sources, and of the need to manage and operate the institution in a more business oriented fashion. Presidents are demanding faster access and more timely reporting of information. The data must be more accurate and complete than ever before. More ad-hoc and exception reports are demanded, and much more institutional analysis is being done, such as enrollment trend analysis, financial forecasting, and retention analysis.

These factors, then, give us the need.

Advantages - Real or Hype?

Let us now list, for discussion, the proposed advantages of "on-line systems", and then examine each to see how true the claims are, and how each contributes to the "hidden impacts".

All data on-line.

Direct and immediate access by the user.

User control.

"Easy" ad-hoc reports.

End-user computing.

Fully integrated.

More accurate.

More timely.

"Hidden Impacts" - What are they?

The hidden impacts of on-line systems are briefly listed below. In the next section we will examine each in detail in relation to the system "advantages" and why each could well be a "hidden impact".

Money. The entire system will cost a great deal more than originally planned, perhaps two to five times as much.

Time. Implementation and operation of the system will require much more time than anticipated, especially for user offices.

Technical training and capabilities for users. User office staff will be required to become familiar with a great deal of computer related technical detail. Probably none was planned.

Institutional policy review and changes. The majority of the institution's policies related to the area in which systems are being installed (eg finance, student records, etc) will be called up for review and probable change.

Organizational interaction and cooperation. The interactions between user offices will change dramatically, forcing a great deal of policy and procedure change as well as improved cooperation.

Hidden Impacts - Class I: Money

Expenditures for the system significantly beyond those originally planned may be brought about through one or more (probably all) of the following "advantages" of on-line systems.

All data on-line. One of the great mysteries in the data processing industry is the apparent inability of project managers to accurately estimate the necessary disk storage for a particular system, even with liberal "safety factors". It's really not much of a mystery, however: the project usually grows in size and scope as it is being developed, but the developer is held to the original estimates. "On-line" systems are particularly prone to this type of hidden impact, since the whole focus of the system is to provide on-line system storage for all necessary data. It is amazing to witness the data storage requirements grow as the user community becomes aware of the potential uses of on-line data. New data elements, or classes of information, are constantly added, and retention periods extend from the original one or two years to four or five years or more. The end result can be to increase disk storage from two to as much as ten times the original estimate.

Additional disk storage will have financial impact in several ways. First, obviously more disk drives will have to be purchased and the maintenance budget increased. If enough disk drives are added, it may also be necessary to increase other hardware components of the computer system such as adding disk channels, controllers, memory, and even central processor capacity. In extreme cases it may be necessary to purchase additional system software to operate and manage the more complex system.

Direct and immediate access by the user. Remembering that the main focus of the system is "on-line" access, it should not be surprising that the number of access points, or terminals, will also grow during the development and implementation of the system. As the user offices begin to understand the full scope of operating the system, the number of necessary access points will increase dramatically. In addition, once implementation has begun, possession of a terminal becomes a very important status symbol: one's job is not important unless one has a terminal. It becomes quickly "necessary" for every clerk in every office to have access to the new on-line system. Again, the number of terminals on the system can grow by as much as an order of magnitude from the original estimate.

The financial impact of additional terminals will be felt not only in the purchase and maintenance of the terminals, but also in associated equipment such as modems, data lines, communications ports and so on. The addition of a great number of active terminals will have the same secondary impact as additional disk drives, it will increase the size of the central computer system. Additional communication hardware, central memory and even central processor capacity will have to be provided to adequately support the additional access points.

Finally, there is a secondary financial impact of adding a major amount of hardware and software to the computer system. Additional staff in the computer service department will be required to operate and support it. Generally, it is not reasonable to expect the same size staff to support a system that has grown twice as large and complex.

Hidden Impacts - Class II: Demands on User Offices

The second area, or "hidden impact", often omitted in planning is that of the creation of a whole set of new demands on the staff in the user offices when an on-line system is implemented. With "end-user computing", the user office not only gets the benefits of the new type of system, but also gets a great many added responsibilities. These new responsibilities fall into several categories, again grouped by the "advantages" of on-line systems.

All data on-line. Having large amounts of data is wonderful, but it is soon discovered that the computer center no longer does the data entry. Since the user office is the focal point of flow and control of the system, data entry is now done directly through the many work-stations in the user offices. Therefore, additional user office staff is frequently required for data entry (although positions may be transferred from the computer center since their data entry group should cease to exist, or at least be dramatically reduced), and training must be provided for these new data entry clerks.

In addition to the personnel required to enter the data, the user office manager is now responsible for making sure that data entry schedules are met, that is, critical data has been entered prior to running a report, and that the data is accurate and complete. These last two items, accuracy and completeness, become critically important in this new age of tougher management. It is just not acceptable to report that there are 250 students whose gender is unknown, or to have missing grades, or, a most critical but frequent problem with these new systems, to have 50 students in the system each with two or even three different ID numbers. The user office manager(s) must work with the computer center in establishing procedures to detect and correct such error conditions.

User control. Having control of your own piece of the computer system is great, too. No longer must you wait for the computer center to run your reports, now you can run them whenever you want to. But wait, has all the data been entered and checked? What about data from other offices? The business office cannot generate tuition statements until all financial aid has been applied, the registrar cannot process applicants until all the admissions data has been entered, and so on. The user office manager now must be aware of the total production schedule for the entire system, coordinate the operation of other offices as well as his or her own, and compromise where necessary to resolve schedule conflicts. Again, staff assignment and training become issues for this important part of running the system.

End-user computing. In a sense, this item is the combination of the first two, but it is worth mentioning in its own right. End-user computing means that the user office has full control and full responsibility for the operation of their piece of the overall system. This means that to realize the full potential of the system, someone in the user office must understand the full capabilities of the system in detail, including (but not limited to) knowing the data base dictionary (DBD), and system interactions and limitations - not only for this office, but other functional areas as well.

Easy ad-hoc reporting. Many software vendors are marketing new retrieval packages, some included with application software, that are called "4 GL's", or fourth generation languages. These 4 GL's are advertised to be so easy to use that user offices can now easily generate their own one-time, or ad-hoc, reports from the on-line system. However, while these languages are indeed easier to use than Cobol or other complex programming languages, they are far from being easy enough for anyone to use. They still require logical thinking and an algorithmic approach to producing a report. They still require systematic problem analysis and solution, and they still require a great amount of attention to detail and much patience and time. In short, not everyone can write a report in a 4 GL, just as not everyone can program a VCR, memorize 10 digit long distance telephone numbers, or calculate their own income tax.

A great "hidden impact" of on-line systems, therefore, can be the realization that someone in the user office must learn, through formal training, how to write reports in this new 4 GL, and be given the time to do it. Once again, staff assignment and training become issues for the office manager. In this case, the assignment can be a real thorny issue depending upon the technical capabilities of the present staff.

At this point let me summarize the hidden impacts on the user office. What has really happened is that to gain the benefit of user control, the user office manager has assumed responsibility for many of the functions that formerly were performed by the computer center. These functions include data entry, production scheduling and coordination, quality control, some system analysis, and some application programming. If totally hidden or omitted prior to system implementation, these "hidden impacts" can be devastating to the unsuspecting office manager. In a sense, each user office becomes its own mini data processing shop. In other words, to avoid the inconveniences and delays of the commercial airlines so that you can come and go as you please, you've had to become a pilot!

The computer center still has work to do, however, in fact a lot more than ever before. The mainframe computer still resides in the central computer center, which is responsible for hardware maintenance, operating system and application software maintenance, and actual operation of the overall computer system. The computer center installs and maintains the hardware and software associated with the data network, and still has production responsibility for large jobs such as payroll, registration, and so on. The computer center is still responsible for the majority of system analysis and application programming, and will spend a great deal of time and effort "customizing" the new on-line system for your particular institution. Finally, the computer center has taken on a new responsibility with this type of system, and that is assistance and training for the user office staff now involved in the operation of the system. This can be a major task for a large, completely distributed system, and will certainly involve additional staff in the computer center as well as in the user offices.

Is it really true? Yes, Virginia, but . . .

Now that the various possible hidden impacts of on-line systems have been exposed, let us examine wether or not the new systems can meet the expectations that their makers create.

Are on-line systems more accurate? Generally, yes. They allow for inclusion of coordinated data, for improved edit checking during data entry, and for checking systematically for missing data. However, for all these features to be of full use, all necessary data elements must be included in the data base, and the data must be continually checked and corrected or "cleaned up". The old data processing phrase "Garbage In, Garbage Out" is still very appropriate.

Are on-line systems more timely? Emphatically yes. By distributing the data entry and production scheduling to the user offices, the classic bottlenecks and delays associated with batch processing in the central computer center are eliminated. Now data can be entered as it is created and one great paper trail, source documents, can be drastically reduced or even eliminated. Also, now that user offices can generate reports at will, there are few reasonable excuses for late reports.

Are on-line systems fully integrated? Maybe. This really depends on your definition (and the vendor's definition) of the term "fully integrated". In general, redundant data (storing the same persons name, address and other biographical information in more than one file, for example) is reduced but not totally eliminated. Also, the various systems are coordinated with each other (eg financial, human resources and student systems), but usually through batch programs or similar linkages. Probably a single system for university administration that meets the pure definition of "fully integrated" would be too expensive to develop and implement to be marketable. In general, however, the systems that are marketed as fully integrated are reasonably compact in their use of data storage, and coordinate data between the various modules well enough to be highly useful.

Conclusion

Now that we've uncovered the hidden impacts and determined that, in spite of them, the system is worthwhile to purchase and implement, how do we avoid the hidden impacts? The two major things to keep in mind are awareness and planning. Hopefully you are now aware of the hidden impacts, and the next step is to include them in the planning process for the installation of your system. This can be accomplished by adding the following ideas to any good data processing project management technique.

Probably the single most important planning function in the entire process, and the one that should be the first major step taken in deciding to make the commitment to an "on-line" system, is to set the overall expectation as to the general size, cost and scope of the new system. How many workstations will be needed, approximately what will the entire system cost (within 10 percent or so), and what will be the impacts on the user offices. This step can best be done by a small, senior management group that has informal discussions with at least two vendors, and visits to at least two other institutions successfully operating a system similar to the one anticipated. By managing general expectations in this manner, hidden impacts, or surprises, should be held to a minimum.

Next, the entire planning and implementation process should be viewed as an iterative process, that is, one that will be revised continually from the beginning. As implementation and training proceed, refinements in requirements will occur, some of them very highly beneficial to the institution, and the process needs to be flexible enough to accommodate this.

Full consideration, discussion and planning should be done for the data that is to be captured and stored, including retention periods. Some allowances should be made for adding data elements, but this portion of the planning should be as complete as possible early in the planning process.

Project teams should be established that include responsible members from the staffs of all user offices that will be impacted by the new system, not just the "primary" users.

"Hidden Impacts of On-Line Systems"
CAUSE '87, Jeffrey W. Noyes

To avoid being cumbersome, project teams should be broken down into functional, or module groups, for example a student system team could be made up of subcommittees for admissions, registrar, financial aid, and business office.

User office managers must know what their new functions and responsibilities will be, plan for them, and make sure that their staff is trained. The overall operation of each user office should be analyzed, both in its current form and how it will operate after the new system is in place. The number and placement of all workstations must be carefully considered, as well as the actual duties of each staff member using the new system.

Extensive training in the capabilities and operation of the new system should be conducted for all project team members as early as possible to familiarize them with the system. If possible, visits should be made to another institution that is using the system, so it can be observed in actual operation and the team members can have a full discussion with their peers about the new system.

If properly designed and planned for, on-line systems won't have any "hidden impacts" and will provide all of the advantages that are expected.

Developing an Institutional Plan for Computing

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The College of DuPage is a community college with a student enrollment of 28,890 students and about 2,400 faculty, staff and part-time students employees. There are many issues today and in the future that will affect higher education. New technologies will have a tremendous impact on how we teach, manage and administer an educational institution. We feel planning for computing provided the institution an organized approach to meeting the challenges of today and the future. This paper is divided into the following sections.

- **Why Plan for Computing**

  This section discusses the major reasons why the College of DuPage decided to plan for computing.

- **How to Plan for Computing**

  This section discusses the steps that were important in planning at the college.

- **A Model of an Institutional Plan for Computing**

  This section reviews the organizational structure of the College of DuPage 'Institutional Plan for Computing'.

Why Plan for Computing

The first step of a planning process is to determine the need to plan for computing. Planning requires a significant resource commitment from an institution. There were ten key reasons why the College of DuPage decided to plan for computing.

- **Provides an understanding of computing on campus**

  We used the planning effort to define the computing resources; hardware, software and support. This provided a basic inventory of all computing resources. In order to share resources, we needed to know what was available on campus.

- **Provides justification for resources**

  In reviewing the existing resources for hardware, software and support and projecting future needs based on new requirements provided additional justification for resources based on current capacity and limitations.

- **Identifies opportunities for effective resource management**

  By evaluating existing equipment on campus provided possible resource sharing, centralized support and reduced maintenance on current equipment and replacement equipment.

- **Identifies threats in the current environment**

  By evaluating existing hardware and software, possible problems were averted.

- **Provides unified approach for goal setting**

  The institution sets individual goals that are supported by all departments.

- **Provides institutional commitment to shared objectives**

  When everyone is involved in the planning process, they tend to work together to meet objectives.

- **Set priorities and timeframes for computing in the relationship to other institutional goals**

  Computing is not the only goal for the institution. By planning for computing you set the appropriate priorities in relationship to other goals.

- **Allows more effective responses to technological changes with the institution**

  Once the strategic direction is determined decisions affecting technology can be made effectively.

- **Provides cost analysis and control of spending levels**

  By effective planning for computing for three years identifies costs and upper limits. In the past it seemed we were providing funds without knowing what next month or next year would bring.

- **Provide a strategic direction to meet the current and future needs of the institution**

  If you have directions your decision making is easier. By planning properly each year you stay on course to hopefully make the right decisions or more so than not planning.

How to Plan for Computing

Planning of computing is not a simple undertaking. It requires a significant commitment in resources from the president to the end users. We feel there are 18 key steps to developing a successful institutional plan for computing.

- **Obtain executive management support and commitment**

The most important issue is commitment and support from executive management of the institution.

- **Setup a team to be responsible for the planning effort**

  Must have a group of responsible people to provide the majority of the work effort.

- **Involve all levels of management**

  Managers, Directors, Vice Presidents and the President were involved in the process. This provided open lines of communication throughout the institution.

- **Identify a planning process**

  You must identify the steps in the planning process to know what has been done and what needs to be done throughout the project.

- **Setup surveys to gather input**

  Surveying is a good method of collecting input on many issues. We found that the best survey was a personal interview with each of the departments.

- **Use reference material to formulate comparative data**

  It is important to compare where you are as compared to other institutions of similar size. Whether you are spending at similar levels or the PC to student ratio can provide some justification. Do not use comparative data as your only justification.

- **Review historical information on current computer usage**

  In order to know where you are going you need to know where you have been. We needed to gather enough historical data to project usage or capacities on the existing equipment

- **Setup institutional committees**

  You need to setup representation from the academic and administrative areas of the institution. The plan must come from the users department not just Computing.

- **Define goals and objectives for each committee**

  The committees should define a set of goals and objectives in order to identify responsibility.

- **Provide constant feedback to all committees**

  It is important to keep all committee members informed on the progress. Minutes should be taken and reviewed for each meeting.

- **Committees must meet on a regular basis**

  Setup a regular schedule of meetings. The frequency will very depending on where you are in the planning cycle. You should meet at least once per month.

- **Committees must have 'active' members**

  Appoint committee members that will participate in the process. The committee members must be willing to work outside the meeting and attend all meetings.

- **Provide adequate time for planning**

  Depending on the complexity of your environment and the scope of the plan, you must provide adequate time for planning. This can take 12-24 months.

- **Limit plan to three years**

  We limited our plan to three years with revisions each year. We felt that planning for any additional years would be a waste of time.

- **Develop an outline for the plan**

Work with the committees to determine what should be included in the plan. Setup a preliminary outline in the beginning. Change the outline as needed throughout the planning process.

- **Review current and future technology**

  You must review the current and future technology in order to compare with what you have and recommend improvements.

- **Define recommendation & action plans**

  Define a set of recommendations for each major area of computing and define the dates for implementation for each recommendation showing the acquisition, installation and production for hardware, software, and support.

- **Define financial considerations**

  The plan should include the cost for each recommendation and if possible, identify funding options and provide a financial plan. We included a unit cost analysis showing the effect of the plan each year on the student cost.

Model of an Institutional Plan for Planning

This section provides an overview of the organizational structure of the College of DuPage's 'Institutional Plan for Computing'. The report was setup to provide an organized and easy to read document for the board of trustees, management and users. The document was prepared using type set quality printing incorporating the use of graphics and tables to improve the presentation.

The plan was divided into seven major chapters; Introduction, The Planning Process, The Current Environment, Academic Computing, Administrative Computing, Central Computing, and Summary Recommendations and Financial Considerations.

Each chapter of the plan contained a section called 'action plans and financial considerations'. This section provided the estimated budgets for capital and operating costs for each item recommended in that chapter. Also included was a timeframe for purchasing the items. The timeframe was divided into acquisition, installation and production. Acquisition was the month for purchase, installation was the estimated installation of the equipment and production was when the user could use the equipment.

Introduction

'Introduction' chapter described the major issues and trends that will impact computing in higher education in the future and provided the justification for planning. A few of the major issues included declining cost of computer hardware, increased demand for computer-related education, software development, staffing and communications.

The Planning Process

'The Planning Process' chapter described the planning process in detail including surveys and committee structures and the flow of planning information and decision making. This chapter of the plan was divided into 'surveys' and 'committees' sections..

Surveys

After designing literally hundreds of questions to solicit the most complete and meaningful data possible, we generated five surveys: the Academic Computing Survey, the Administrative Users Survey, the Administrative Computing Departmental Survey, the Academic Computing Departmental Survey, and the Community College Survey. Each survey was designed to gather the appropriate information from a group of users. We found the departmental survey provided the best information for planning. In the departmental survey we interviewed each dean and director.

Committees

We setup five committees on campus to be responsible for the different levels of planning.

Academic Divisional Computer Committee - ADCC

Each academic division identified three to five faculty members involved in computing. These members served on the Academic Divisional Computer Committee to address computing needs. Their responsibility was to:

- Define long range computing objectives
- Define the importance of the computing objectives to the instructional process
- Collect information from the division and incorporate the information into a computing plan for the division
- Provide a divisional plan to the ACPC committee which identified anticipated and projected new computer use and direction for computing at the divisional level

Academic Computer Planning Committee - ACPC

The Academic Computing Planning Committee consisted of faculty representatives of each academic division, two academic deans and the Manager of Academic Computing. The charge of the committee was to gather and evaluate information as provided by the Divisional Committee and Computing and Information and use this information to:

- Define the current computing environment
- Evaluate computer resources and support
- Make suggestions on how to improve computing
- Define academic computing needs and objectives for the college
- Review of ongoing divisional computing needs

Administrative Review Committee - ARC

The Administrative Review Committee consisted of Deans and the Executive Director Computing and Information. This committee reviewed the information provided by the ACPC and provided a higher level review of the proposal. The committee was responsible for:

- Reviewing the divisional needs
- Providing additional input on divisional needs
- Recommending a priority of the needs
- Reviewing goals and objectives

Administrative Systems Users Advisory Committee - ASUAC

The Administrative Systems Users Advisory Committee consisted of major computer users and director/dean level representatives from the five administrative units (Main Campus, Open Campus, Administrative Affairs, External Affairs, and Planning and Information) as well as the Executive Director, Manager Administrative Systems, and Manager Information Support Services from Computing and Information. The committee was responsible for:

- Reviewing and prioritizing all administrative programming requests
- Providing input from their units on computing needs for hardware, software and support
- Providing input on future computing needs
- Formulating the Administrative Computing Plan
- Evaluating the Administrative Computing Plan
- Reviewing ongoing unit needs

Computer Services Management Committee - CSMC

The Computer Services Management Committee consisted of the President, Vice President Planning and Information, Vice President Administrative Affairs, Vice President External Affairs, Provost Main Campus, Provost Open Campus, and the Executive Director Computing and Information. The committee was responsible for:

- Reviewing the academic planning recommendations
- Reviewing the administrative planning recommendations
- Reviewing the future direction recommendation
- Recommending priorities
- Recommending funding levels to the Board of Trustees

Final funding decisions for the Institutional Plan for Computing was made by the Board of Trustees during its review.

Current Environment

'Current Environment' chapter described the current computer facilities in terms of computing support, hardware and software. The chapter was divided into two sections, Computer Support and Computer Systems and Facilities.

The computer support section identified all the departments providing computing support with respect to personnel. The amount of support was defined in FTE's, full-time equivalents and the type of support i.e., programming, consulting and training.

The computer systems and facilities was divided into five areas: mainframe system resources, minicomputer system resources, office automation resources, microcomputing resources, and academic computing lab facilities. Mainframe, mini and office automation resources were subdivided into descriptions for the major workload, system hardware, system software and application software. 'Microcomputing resources' was subdivided into administrative and faculty resources. The 'academic computing labs' was subdivided into hardware in the lab, description/purpose of lab, management and staffing.

Academic Computing

Academic Computing included all of those activities which were integral to or related to student instruction in computer-related disciplines, or other instruction which relied on computers. This included all computing functions which either assisted instructors in the development or maintenance of course materials or facilitated students in the learning process. Academic Computing involved all of those activities which support the use of computers such as the maintenance of hardware, the integration of software into instructions, the preparation of support materials, personal consulting or problem solving and the management of lab facilities. Academic Computing also involved those activities which promoted the growth in the use of computers such as the consideration, selection, and review of hardware and software; training for computer literacy; computer planning and the development of new academic applications.

The Academic Computing chapter was divided into 'Student Usage', 'Hardware Needs', 'Software Needs', 'Support Needs' and 'Action Plans and Financial Considerations' sections.

An Academic Computing Departmental Survey provided information which allowed for projections of computing needs over the next three years and also how hardware and software resources should grow to support those needs. We provided a brief description of the major instructional divisions for Main and Open Campus, and the level of computer usage for these areas.

Growth projections were presented in terms of the number of additional students and contact hours, as well as a written description of those areas where growth is expected to occur. This included a description of new applications or systems that may be used over the next three years.

Projections in the number of additional computer stations were determined for the college as a whole for each type of computer resource.

Faculty access to computer resources was evaluated and compared to the number of computers which are needed over the next three years. The Academic Computing Departmental Survey provided information on the current amount of money budgeted for software by each area of the college and the projected percentage increase which is needed over the next three years. The Academic Computing Survey provided a description of the applications which are needed.

Student computer support was also evaluated by determining the current level of support in terms of FTE support staff per number of computer users and then projecting how support should increase over the next three years to maintain the current level of support. The current level of faculty computer support was also determined and the importance of various types of support was evaluated. A comparison will also be made between the number of support staff available to students and faculty at the College of DuPage and the other community colleges which were surveyed.

Administrative Computing

Administrative computing included all the information processing services which provide the college management with the data necessary to make decisions, record data, and carry out the day-to-day operations. The major administrative functions/applications included payroll, personnel, general ledger, accounts payable, accounts receivable, purchasing, student registration and records, financial aid, inventory, word processing, and management information system.

Several issues pertaining to administrative computing was addressed to provide an acceptable level of service and support:

- Provide users adequate online response time, i.e. quick access to data
- Provide users with adequate disk space to store their data now and for the future
- Provide users with a security system to maintain the integrity of the data
- Provide users applications that are flexible and easy to maintain and modify
- Provide users applications that are accurate
- Provide users the tools to access their data and generate their own reports and analysis
- Provide users consulting support for their applications
- Provide users with training on how to use an application
- Provide users with user documentation for ease of use
- Provide users with flexible operational hours
- Provide technical expertise to evaluate current and future applications

Administrative computing was divided into 'software', 'hardware' and 'support' needs. Software included major administrative applications and end user applications. All major administrative applications were supported by Computer and Information and were usually run on a mainframe or minicomputer. The end user applications dealt with "tools" that were used by end users to perform their jobs. This would include microcomputer-based applications and decision support systems.

Software Needs

Administrative Software Needs

The major administrative software applications at the college included: General Ledger System, Human Resources System, Financial Aid System, Student Billing and Receivables System, Student Records System, Capital Assets System, Management Information System, CLSI Library System, Response System Variable Prescription, Office Automation

For each major application we provided a 'description' of the application, who were the 'users', 'current problems and concerns', 'growth estimates' and made 'general recommendations' for the system.

End User Software

End user software consisted of any application that existed on user personnel computers or on fourth generation applications on the mainframe. We surveyed the user departments to identify the computing functions that were needed. The functions were divided into nine categories: graphics, electronic mail, text management, high quality printing, statistical analysis, data management, report writing, project management and download PC.

Below shows a graph of the computing function needs of users. This is an example of how we used graphics in the plan.

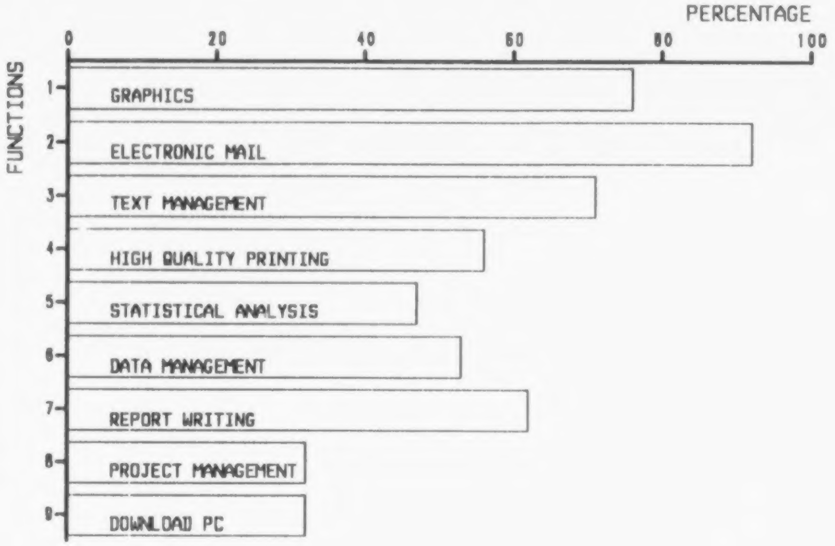

Figure 49. Computing Function Needs of Users

Support Needs

Computing support was divided into four areas: training, programming, documentation and consulting. We surveyed the user departments to determine the major support area.

Computer support is provided by several areas of the college. In the departmental survey we requested users identify areas of support that needed improvement. The following figure shows the individual departmental support needs. This is another example of the tables we included in the plan

DEPARTMENTAL SUPPORT AREA NEEDS

DEPARTMENTS	*SUPPORT AREAS** *1*	*2*	*3*	*4*
PRESIDENTS				
Office of President	X			
Auditor	X			
MAIN CAMPUS				
Office of Provost	X			
Automated Office	X			
Instruction			X	X
Humanities & Liberal Arts		X		X
Social & Behavioral Sciences				
Natural Sciences				
Occupational & Vocational Education	X			
Business & Services	X			
Student Affairs	X	X	X	X
Learning Resource Center				
OPEN CAMPUS				
Office of Provost	X			
Academic Alternatives	X			
Business & Professional Institute				
Regional Center - Southwest				
Regional Center - East	X			
Regional Center - North	X			
Community Education	X			
ADMINISTRATIVE AFFAIRS				
Office of Vice President	X			
Campus Services	X	X		X
Auxiliary Enterprises	X	X		X
Financial Affairs	X	X	X	X
Human Resources	X	X		X
Purchasing	X		X	
Public Safety				
PLANNING & INFORMATION				
Office of Vice President	X			
Computing and Information				
Admissions, Registration & Records	X		X	X
Research & Planning	X	X	X	X
EXTERNAL AFFAIRS				
Office of Vice President	X			
Public Information/Media Production	X	X	X	X
Development	X			
Campus & Community Events	X			

***1-Training 2-Programming 3-Documentation 4-Consulting**

Figure 1. Departmental Support Area Needs

Hardware Needs

In the hardware needs section within Administrative Computing we included all departmental personal computers, terminals and printers. This need was defined by each department requiring access to the mainframe and departmental applications. Although the equipment was included in the plan, each department had to budget/fund the equipment from their own budgets. This provided flexibility within each department to set their own priority.

Central Computing

Central Computing was all the support in system hardware, software and personnel that was shared with academic and administrative computing. This included governance issues, computer operations, system hardware, software and support and campus-wide communications. This section evaluated the central computing concerns and recommended a direction in each area that would meet our current and future needs.

Governance

We reviewed the governing authority of the organization in dealing with computing on campus and recommended changes that would improve planning and the operation.

System Software Needs

Systems software are the program/applications that support the operation of the central computing facility. This included a review and appropriate recommendations for operating system software, security, performance monitoring, system accounting and charge back, and data center management software.

Support Needs

We reviewed the support needs for systems and operations. Recommedations were based on current and future acquisition of application and system software. Data base and security were key areas for support.

System Hardware Needs

Computer equipment needs were based on the growth of existing applications and new applications that are to be purchased or developed. In situations where the growth exceeds the capacity and the capacity cannot be expanded, the equipment must be replaced. If the equipment cannot perform a certain necessary function, even with upgrading, then the equipment must be replaced. In the following sections we identified the hardware component needs for the next three years.

Computer equipment needs on the IBM system were defined by four major areas: 'disk space', 'ports', 'CPU memory', and 'CPU power in MIPS'.

Disk Space

The disk space was defined by the current application usage including administrative, academic, and systems; the estimated growth from 1988 to 1990; and the new applications that are planned over the next three years.

We provided tables with current and new application disk space requirements. The disk space requirements were projected for the next three years. A graph in the plan showed the disk space used vs. available and projected the growth through 1990.

The disk space was defined by administrative software applications and system software applications. The administrative software application disk space included storage for all the data files, work areas, and programs that support the application. The system software applications included disk space that was required for operation of the computer systems software.

The same approach was used for 'ports', 'CPU memory' and MIP capacity. Graphs were included in the plan showing trends. Recommendations were made based on the current and future application needs.

Communications and Networking

We reviewed the communications and networking needs on campus. We discussed the problems with incompatibility of computer systems. The users were surveyed on connectivity needs and a table was included on which systems needed to talk to other systems. Several strategic directions were defined for communications and networking along with a recommendation to develop a plan for telecommunication on campus addressing voice, video and data.

Summary Recommendations

This chapter provided summary recommendations and financial considerations for academic, administrative, and central computing for fiscal years 1988-1990. Included are sections summarizing the staffing needs, the total institutional financial considerations with various funding alternatives.

Academic Computing

This section summarized all the recommendations for Academic Computing. The recommendations were divided into hardware, software, support for faculty and students. A financial table was included showing the cost by fiscal year for operating and capital costs.

Administrative Computing and Central Computing

Administrative Computing and Central Computing sections were defined using the same approach as the academic computing section on recommendations and financial considerations.

Support

We summarized in one table all the staffing needs for the next three years. Each new position requested was identified including a summary justification for each.

Institutional Financial Considerations

This section was divided into a summary of cost for administrative, academic and central computing by fiscal year. We included sections on funding alternatives and a financial plan. The financial plan showed tables on actual vs. estimated budget for FY84-FY88. We provided several funding options including financing and setting up a general computing lab fee. The last part of this section included a unit cost analysis of actual vs. projected assuming the plan was funded.

LONG-RANGE STRATEGIC PLANNING IN A DECENTRALIZED ADMINISTRATIVE INFORMATION SYSTEMS ENVIRONMENT–PHASE II STRUCTURE, CONTENT AND IMPLEMENTATION OF THE PLAN

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Abstract:

This is a continuation of the paper presented at the 1986 CAUSE meeting. In that presentation we described the events that led to the decentralization of administrative information services, the creation of the position director of administrative information services, the process for making the new organization work, and the approach to developing the strategic plan for AIS. This paper will focus on the actual planning process and the content of the Plan. The Plan starts with a statement of planning assumptions and a discussion of critical issues. Goals are developed based on the issues and assumptions. Finally, implementation strategies are discussed specifying appropriate information technologies that address the goals, assumptions, and issues.

LONG-RANGE STRATEGIC PLANNING IN A DECENTRALIZED ADMINISTRATIVE INFORMATION SYSTEMS ENVIRONMENT-PHASE II STRUCTURE, CONTENT AND IMPLEMENTATION OF THE PLAN

I. Overview

In the last paper we described how the authority, responsibility and accountability for administrative services and related information systems was distributed to the chief administrative officers. Responsibilities were divided between the administrative departments and the central computer center. The director of administrative information services position was created to provide overall coordination of the planning and delivery of university-wide administrative information systems, services and management reporting. A committee structure was established to provide leadership and direction in the continuing development and coordination of the university's administrative information resources.

A five year plan had been developed in 1981. The priorities established in that plan were essentially implemented. However, priorities and the environment had changed dramatically demanding an update to that plan. Since that plan focused entirely on application systems it was necessary to broaden the scope of the new plan to consider all strategic issues. After considerable research a planning methodology was chosen and the planning process begun. Good progress was made in the first few months but then delays occurred that were precipitated by a variety of factors such as, conflicting priorities, scheduling problems, and lack of expertise. Use of an outside facilitator expedited the planning process and resulted in open discussions that succeeded in identifying issues and developing recommendations for strategic solutions.

This paper describes the results of the planning process by reviewing the planning document in terms of its organization and specific content. Finally, progress to-date in implementing the strategies developed in the plan is reviewed.

II. Structure of the Plan

After trying a number of different ways to organize the information in the Plan, the following structure was selected because it is consistent with other university planning processes. This structure also provides the desired transition from the conceptual framework of the Plan and specific work that has to be accomplished to execute the Plan:

A. Executive Summary

Highlights and summarizations are taken from the chapters of the Plan and presented in this section. Included are the two top priority courses of action and additional priorities as outlined in the Plan. This is followed by a short synopsis of the nature of the Plan and the issues upon which the goals and strategies of the Plan are based.

B. Introduction

This section describes our past planning activities and the sponsorship and objectives of the current plan. It provides continuity with past planning efforts and points out the status of implementing the plans.

C. Planning Assumptions

Broad statements that create the basic foundation of the Plan are presented in this section.

D. Issues

This is probably the most important part of the Plan because it is in this section that the planning group identifies the most important administrative systems topics that need to be addressed.

E. Goals

The stage is now set for closing the gap between the conceptual background and the actual work that needs to be done. This is accomplished by developing specific information systems goals based on the planning assumptions and issues. For this purpose the area of information systems was divided into information management, departmental computing, central computing, organization, communications, security, and applications systems.

F. Strategies

With this background, current technologies are examined to determine alternative solutions that address the issues and help achieve the goals identified previously. As in the previous section the strategies are organized according to information management, departmental computing, central computing, organization, communications, security, and application systems. Each set of strategies is preceded by a description of the current environment to insure a common understanding of our starting point.

III. Content of the Plan

A. Executive Summary

Recommendations

This section outlines the major recommendations that are developed in detail in the Plan. Since the Plan is strategic in nature, and the intention is to provide a long-range blueprint, a detailed cost analysis and implementation schedule are not included. These items were considered implementation issues that will be addressed as subsequent tasks. However, in order to provide some sense of priority, the two most important strategies were identified.

The first strategy is to implement a modern data base management system for the purposes of promoting access to data, organizing data to support decision making processes, and improving the quality of data, while at the same time protecting the current investment in applications systems.

The second priority is to provide for connecting administrative departments for the purpose of electronically transmitting transactions, documents, and messages.

Other recommendations consist of continuing with the operation of the central computing utility, improving communications between planning committees, considering establishing user support functions to support newly implemented technologies, developing an administrative network strategy, developing and implementing departmental and central data security policies and procedures, and improving departmental applications systems.

Issues

Three main issues have been identified in the Plan as user computing, connectivity, and decentralization vs. centralization.

User computing is a concept that conveys the importance of focusing on the needs of the users and their direct access to computing resources for the purpose of accomplishing their job responsibilities.

Connectivity refers to the need to access and use administrative data, the ability to electronically create and revise documents, create messages and distribute them throughout the university.

Decentralization vs. centralization speaks to the concept that the two organizational models are not mutually exclusive but are in fact complementary. Responsibility for applications development has been decentralized but data management and certain support functions are best managed centrally.

B. Introduction

This section of the Plan starts with a general introduction, discusses some of the related planning activities and why this plan is necessary, gives the background for decentralizing the administrative applications systems, and reviews the current status of the planning committees. The Plan should have certain characteristics in order to make it effective. The following characteristics are discussed in this section: The Plan needs to contribute to the university's long term goals, it needs to maintain a broad scope, it needs to have wide participation, it must be needs driven, and must have the full commitment by senior management.

C. Planning Assumptions

Through the use of assumptions the planning group is able to address a variety of perceptions, ideas, trends, needs, etc. and, thereby, set the stage for assessing the current environment and determining future needs. Much discussion and careful editing have gone into preparing thirteen assumptions, the most important of which are presented here:

- The responsibility for administrative application systems is delegated to the respective administrative department managers while the administration of overall data structures is centralized.
- Access to information, including the converting of data into information, is the central focus in administrative information systems planning.
- Users will play an increasingly active role in designing, developing or acquiring, implementing and managing administrative information systems.

D. Issues

User Computing

User computing is a relatively new phenomenon that has evolved primarily as the result of gaining direct access to computing resources by users throughout the institution.

The classic aspect of user computing is the applications systems that support user functions. This has been the focus of systems plans and actions over the last several years. Decentralization of application development has helped accelerate progress in improving current applications systems.

Besides the work necessary in the applications areas, there is a need to address the information gathering, processing, storing and reporting requirements of the university. The major shortcoming of the current data access methods is the inability to easily combine data extracted from two or more files.

Other aspects of user computing are how to determine the need to access data, what criteria to use to limit access to data, the concept of data ownership vs. data custodianship, and responsibilities on the part of users.

Finally, as a result of making data more accessible, a rising concern will be the support users may require in deciding how to properly use data.

Connectivity

Connectivity refers to sending and receiving information electronically among and between offices inside and outside the university. Functions associated with connectivity can be classified as reading, updating, and printing administrative data, electronic mail, calendaring, and document storage and retrieval.

Based on a survey the following recommendations were made:

- Provide administrative and academic units the ability to electronically read, update, and transmit administrative data.
- Provide administrative and academic units the ability to electronically create and revise documents, create messages, and distribute both throughout the university.
- Encourage access to office automation for administrative and academic units where no access now exists.

Decentralization vs. Centralization

The central administrative data processing staff was distributed to major administrative areas as part of implementing the plan to decentralize administrative information systems management. Departments have reallocated positions and looked to contractors to supplement permanent staff in order to help address their needs. Several offices, such as the deans' offices, have not been provided with technical staffs and do not have central support staff available to them. There is a need to provide these offices with adequate technical support.

The installation of on-line administrative systems has caused increased competition for central computing resources. As a result, the current capacity of the mainframe could be exceeded in the very near future.

The structure and relationships of the computing policy and advisory committees are not clear. The purposes of the committees, their memberships, and their interrelationships need to be reviewed and defined.

E. Goals

Goals are defined as statements that describe **what** needs to be accomplished over the foreseeable future without specifying **how** to accomplish it. Following are some of the major goals as they are categorized in the Plan:

Information Management

- Create an environment that promotes access to and availability of data within prescribed limits of management control.
- Provide for the migration of current administrative systems files to a data base environment while protecting the investment in current systems and expertise.

Departmental Computing

- Ensure compatibility among departmental and central computers for the purpose of communicating between them as the need arises.
- Provide administrative and academic units the ability to electronically create and revise documents, create messages, and distribute both throughout the university.

Central Computing

- Continue using the central host computer for shared applications and to achieve economies of scale.

- Provide for compatibility with departmental computers for the purpose of interconnecting and sharing data and programs as necessary.

Organization

- Enhance the management of administrative information systems.

- Integrate information services into each administrative function in the university.

Communications

- Provide for greater communications integration between administrative and academic systems.

- Provide for the merging of data, voice, graphics, and image processing.

Security

- Make all information available except where sufficient cause to limit access can be demonstrated.

- Security requirements should not unduly impede access.

Application Systems

- Continue the process of converting to on-line transaction systems where appropriate.

- Improve the productivity of system designers and programmers by utilizing modern system development technology.

F. Implementation Strategies

Information Management

The strategy for achieving the institution's information management goals is to acquire and implement a state-of-the-art data base management system. A primary consideration is to protect the current investment in applications software. In implementing the data base management system, the university should have the flexibility to utilize a combination of transparency, extract, and native data access approaches.

This strategy was developed by identifying various criteria to evaluate a number of viable options to migrate to a modern data base environment. The criteria consisted of ease of access, controlling access to data elements, ease of manipulating data, costs, implementation effort, host impact, application impact, need for support staff, product support, and need to maintain independent departmental data bases. Two implementation strategies were considered: (1) implementing a data base management system that is integrated with the application systems; (2) implementing a data base management system without changing the existing application systems.

The first option was ruled out on the basis of cost, since it required the replacement or reprogramming of all applications systems. The second option involved really three different access modes: a transparency mode, an extract mode, and a native mode. Since each mode offers advantages and disadvantages, the ideal solution is to have the flexibility to employ all three modes depending on the files or systems being accessed.

Departmental Computing

One strategy relative to departmental computing involves administrative applications. With the advent of decentralization and the development of departmental and personal computers, local solutions are favored whenever it is economically and managerially feasible to do so. Current technology supports a four-tier architecture consisting of the mainframe, departmental processors, personal computers, and supercomputers. Administrative systems support this architecture by encouraging users to select solutions that best meet their needs.

Another strategy with respect to departmental computing deals with the common departmental need to electronically create and revise documents, create messages, and distribute them throughout the university.

Current departmental computers consist of IBM, Wang, Digital Equipment Corporation, and NBI systems. Considering the mixture of departmental computers, two alternative solutions were considered. One solution involves the installation of an electronic mail system on the central host computer. The second solution is to install a software product that translates the various existing document formats in a way that is transparent to departmental office systems users.

The first solution was eliminated on the basis that it creates a dual system environment in each office. This is both costly and confusing and would probably result in user dissatisfaction and consequently lack of use.

The second solution is clearly the more desirable approach provided that viable products are available that address the required functions.

Central Computing

An extensive analysis of CPU usage revealed an annual increase of CPU usage of 25%. Based on this analysis and forecasted usage the conclusion was that a CPU upgrade is urgently needed and a change in operating systems is required.

Although the implementation of a data base system and a connectivity solution have both an immediate and long term effect on the host computer, the conclusion by the Computer Center is that this effect will not seriously alter the projected demand trend on the central Computer Center.

Organization

For a variety of reasons, computing planning committees and the functional units have tended to work independently. There is a need to develop means whereby there is periodic communication between these groups for the purpose of keeping each other informed of general plans and ideas and identifying any issues that might require close coordination.

University decision support systems, data administration, and the evaluation of the quality, integrity, and use of data elements in the university's administrative systems data bases need to be implemented.

Membership of the Administrative Information Systems Advisory Committee needs to be broadened to include Library Services, the Provost's Office and technical representatives from the academic areas.

As a result of involving a broad set of users more directly in the use of new technology such as, data base systems and office connectivity tools, assistance to users in the form of training, demonstrations, consulting, counseling, and trouble shooting is necessary. For that purpose separate support functions will be established and responsibilities, staffing requirements, and organizational affiliations will be determined.

Communications

Data access and transmission requirements are expected to grow significantly over the next several years and will probably become more complex as the need for automated support increases. The proliferation of hardware throughout the university requires a highly flexible and responsive communications network.

The university's Communications Steering Committee and its Subcommittee are charged with the development of the university-wide communication strategy for voice, data, and video capabilities. Plans are already underway to develop a communications architecture for the university, to implement an academic data network, and to take advantage of the Integrated Digital Services Network that is being implemented by the local telephone company.

Security

A university-wide security coordinator has been designated with responsibility to work with security officers and internal audit to develop a university security program.

Special attention will be directed towards how the information management strategy could impact security. The newly created data administration function will coordinate the development and implementation of a variety of data security policies and procedures.

Application Systems

This section provides a detailed description of the current systems of each administrative department and the application systems development plans over the next two to three years. Each department has prioritized their projects and stated estimated completion dates. Lack of space prohibits the discussion of the various projects but the following is a summary of some of the major scheduled projects:

Facilities Work Control System
Architectural Computer Assisted Drafting System
Building Attribute Data Base
On-line Cashiering System
New Purchasing System
Improve access to administrative data
Public Safety System
Telephone Billing System
Office Automation System
Voice Response Systems

III. Implementation of the Plan

In summary, the Administrative Information Systems Strategic Long Range Plan is the product of eighteen months of effort by the Administrative Information Systems Advisory Committee and its Operations Subcommittee. The focus of the Plan is to identify critical issues, goals, and strategies. It does not attempt to comingle strategies and priorities across major categories. The document was developed as a blueprint for future implementation and, therefore, does not include a specific timetable or resource needs. As the Plan is implemented, the resource needs and implementation timetables will be clarified.

Solutions

The first step toward implementing the Plan was to identify the top priorities. The consensus is that information management and departmental connectivity represent the top two priorities and efforts should be made to find viable solutions for these strategies.

Information Management

Extensive discussions have been held with a number of leading Data Base Management System vendors. The discussions have focused on the benefits of implementing a data base management system and how to migrate to a data base environment. After several months of analysis, two points became clear. First, in order to obtain the major benefits of a relational data base, our current file structures would have to be changed to relational files. Second, since our major systems consist of vendor supplied packages, we couldn't reprogram the systems without losing vendor support. This implied that we needed new applications system packages that are integrated with a relational data base.

After a few inquiries it became apparent that these types of packages were not available from our software vendors. Therefore, we have elected to implement an intermediate solution. This solution consists of software that enables end users to access data in the existing files without the need to know where the data is located and without the need to alter the existing file structures. This type of product typically contains a data dictionary, a query language, and an interface to existing file access methods.

Departmental Connectivity

The challenge in this area has been to find viable products that could manage the variety of office systems that have been installed by administrative departments. IBM's Distributed Office Support System (DISOSS) had been assumed to be the only product that adequately addresses the university's needs. In response to concerns expressed about the viability of that product, a task force was appointed to research DISOSS. The report by the task force indicated that DISOSS would meet our needs and suggested that there might be other products on the market that compete with DISOSS. Upon further inquiry it was determined that products from Softswitch could also address departmental connectivity functions. We will soon be entering into a competitive procurement for this type of software product.

Organization and Funding

In order to address a number of lingering issues that have been created as a result of decentralization, a team of three outside consultants were engaged to make recommendations regarding how the computing function should be organized and to review the existing computing and communications plans for the hospital, academic computing, and administrative computing.

The following are some of the primary recommendations by the consultants:

- Computing controversies should be resolved by using three vice presidential deputies to develop consensus recommendations to the three vice presidents. Issue-specific task forces should be utilized in this process.

- All present advisory and policy committees should be dissolved and a new committee structure be constituted.

- University objectives relating to computing and communications should be clarified.

By combining the academic and administrative top priorities, based on independent planning efforts, the following computing priorities will be implemented:

- Central computer upgrade

- Academic networking

- Administrative data access

- Administrative connectivity

Track II
Innovative Management

Coordinator:
Carole Barone
Syracuse University

Papers in this track describe unusual techniques for acquiring information technology, for utilizing the technology to maintain an acceptable level of operation, or for innovative management in the academic arena or administrative areas such as finance, space management, personnel student management, and development.

Brian P. Nedwek
St. Louis University

Ken Blythe
Penn State University

Diane Kent
University of British Columbia

Is this Creative, or What!

Kenneth C. Blythe

The Pennsylvania State University
University Park, Pennsylvania

How do we bring innovation to the Administrative computer business? Competition demands that we seek new technological initiatives that make a difference. New systems should not be developed as a matter of rote but as a matter of strategic importance. But, how do we do this? By recognizing that the most important things are not always most apparent. Someone must take leadership and explain that traditional remedies are not always creative remedies; that computer specialists can become absorbed in minutia and forget the dream. Let's get things on track and remember that we harness the most important tool of the century for organizational efficiency and effectiveness. This paper is a report on innovation in Penn State administrative computing.

IS THIS CREATIVE, OR WHAT!

What an exhilaration! Here, at my desk, I can inquire into databases that are in my personal computer or in computers that are thousands of miles away. I can inquire about census data, health data, student data, financial data . . . all within easy reach . . . right from my desk. I can visit libraries with millions of volumes, search for articles, connect with others who have published before me. I can work at home or in the office in a continuum that knows no geographic or time boundary. I can collaborate, electronically, with writers and thinkers and managers like myself across the nation . . . at my desk. What are the limits? Where are the boundaries? Only in my mind.

Is this creative, or what! It is the very essence of creativity. In all of my career experiences, none match the creativity that I experience at Pennsylvania State University. The University is alive with creative ideas and bold conceptions of the application of technology. Examples of this creativity are numerous and I will try to touch on a few along the way. But, it is not my purpose to demonstrate Penn State's creativity as much as it is to discover the reasons for it. Just what is creativity and how is it activated?

I submit that the first requirement to activate creativity is to recognize when creativity is at work. The relentless pace of change, these days, obscures the investment that is made in one change as compared to another. Creative changes are absorbed as just another pedestrian, day-to-day occurrence. Is it spectacular that thousands of individuals can access a single database simultaneously? No, not particularly. Is it amazing that we can transmit electronic mail nationwide? No. Once, it was amazing, but no more. And why is this? Because it is the nature of creativity that it is creative only once. Then, it becomes prudent. Telephones, for example, are not thought to be creative, but they are certainly prudent. Most businesses could not get along without them. This, then, is a clue to the nature of creativity. It is a transitory event. We, who are in the business of high technology, must recognize that one creative event is not long lasting. It is no longer satisfactory to achieve a single creation. As the agents of change in our institutions, we must seek an environment that produces a continuous stream of innovative changes. To quote Warren McFarlan of the Harvard Business School, the information systems function is "in the business of bringing a sustained stream of innovation in information services to change the company's internal operations. . . and external products."[1]

ART OR SCIENCE

As long as I can remember, it has been debated whether computer programming is an art or a science. Is the creation of a computer program analogous to the creation of a watercolor painting or cataloging the stars of the universe? The question is important because it leads to conclusions about the management of computer programming, systems development and technological change, in general. Ignored in the debate is the much more fundamental question of creativity. In our quest to categorize technological change we have failed to understand its underlying creative nature. Because we conclude that technological change is more science-like than art, we tend to focus on "method" rather than "result." We "administer data", "initiate projects", "define requirements", "prepare reports", "develop programs" in a structured way. Hardly ever do we brainstorm or monitor the sources of innovation. Why? Because that is the way we've been taught.

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[1] F. Warren McFarlan and James L. McKenney, Corporate Information Systems Management: The Issues Facing Senior Executives, Richard D. Irwin, Homewood, IL 1983

Believe it or not, the popular conception is that technologists are creators. We are thought to hold creative solutions to social progress, efficiency and institutional success. Given that this is true, lets get on with it. Let us understand the factors of creativity and how they are applied.

WHAT IS CREATIVITY

To define creativity, I will begin with a quote from Herbert Simon:

> *"About forty years ago, the Federal Courts put themselves in the position of requiring that for an invention to be patentable there must be proof that a "spark of genius" had occurred. The language was Mr. Justice Hand's. The trouble with sparks of genius, and similar evidences of creativity, is that they are not photographable, hence are difficult to introduce as evidence. As long as we refer to acts of creativity with awe and emphasize their unfathomability, we are unlikely to achieve an understanding of their processes. Fortunately, it is not necessary to surround creativity with mystery and obfuscation...The simplest way to find a definition of creativity is to observe when people apply the term "creative" to some human act. Acts are judged to be creative when they produce something that is novel and that is thought to be interesting or to have social value . . . But in the last analysis, each field must make its own judgements of creativity; each must decide what is novel and what products are interesting or valuable."*[2]

Notice that this description does not deny that "spark of genius" is a characteristic of creativity but it is not the only characteristic. Another clue to creativity is that it is more often the result of hard work, dedication, chance or timing than "spark of genius." Thomas Edison tried literally thousands of materials before he came across a suitable light bulb filament. He attributed invention to "99% perspiration and 1% inspiration."[3]

Creativity then is an ACT that produces SOMETHING which is NOVEL and has VALUE. The outward sign of creativity is CHANGE. Not any change but novel and valuable change. Change for the sake of change is not creative. Change that makes a difference is creative because it is novel and has value.

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[2] Conference Proceedings *Frontiers in Creative and Innovative Management* edited by Robert Lawrence Kuhn, Ballinger Publishing Company, Cambridge, Massachusetts, 1985

[3] Robert Friedel and Paul Israel, *Edison's Electric Light*, Rutgers University Press, New Brunswick, New Jersey, 1986

CREATIVE MANAGEMENT

Peter Drucker is the best source I have found for instruction in creative management. His book, *Innovation and Entrepreneurship*,[4] explains clearly how to be innovative. Being innovative (i.e.: creative) requires that you view your job differently. It requires personal transformation from developer to creator. Let me explain with an example. **Figure 1** is Drucker's innovation model and ***Figure 2*** is the traditional systems development model. **Note the difference.** The traditional model begins with PROBLEM DEFINITION as compared to the innovation model's SOURCES OF INNOVATION. PROBLEM DEFINITION is a narrower objective than searching, first, for the sources of innovation. Do problems always precede innovation? Certainly not. As offices of technological change, we are on the cutting edge of our institutions and should recognize what we are cutting . . . red tape, partially; inefficiency, partially . . . but more than that, we are cutting new trails. If we start with a narrow, problem solving conception we will shackle to lowered expectations. For the sake of our institutions, we must seek broader opportunities rather than problems; creations rather than solutions.

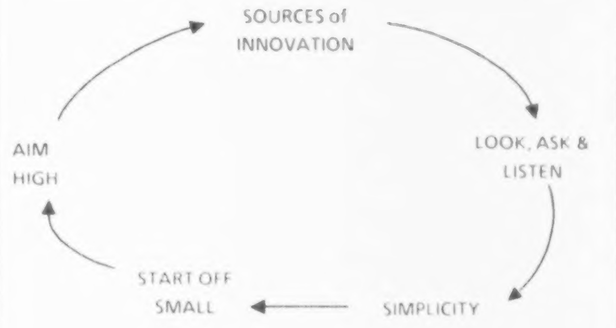
SOURCES of INNOVATION
LOOK, ASK & LISTEN
SIMPLICITY
START OFF SMALL
AIM HIGH

FIGURE 1 Principles of Innovation

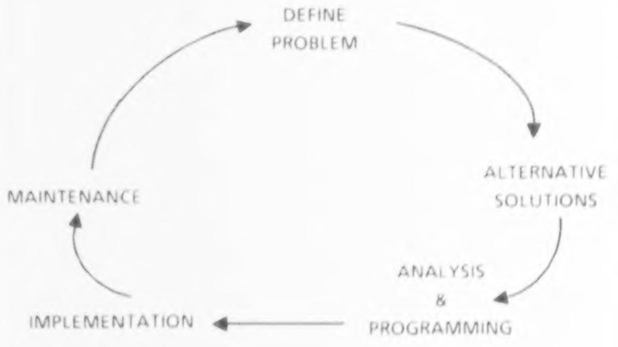
DEFINE PROBLEM
ALTERNATIVE SOLUTIONS
ANALYSIS & PROGRAMMING
IMPLEMENTATION
MAINTENANCE

FIGURE 2 Traditional Model

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[4] Peter F. Drucker, *Innovation and Entrepreneurship*, William Heinemann Ltd, London, England, 1985

THE INNOVATION MODEL

Using Drucker's model (Figure 1), I will briefly review some innovative activities underway at Penn State. Keep in mind that innovative changes are those that are novel and have value. For the sake of understanding at Penn State, novel means new to Penn State. It does not mean universally novel. Voice response registration, for example, is novel at Penn State even though it has already been implemented at other institutions.

Sources of Innovation

The first step of Drucker's model is to look for the sources of innovation. Before rushing into something with low value, take the time to survey the opportunities to innovate. As Drucker explains, *"it is change that always provides the opportunity for the new and different. Systematic innovation therefore consists in the purposeful and organized search for changes, and for the systematic analysis of the opportunities such change might offer for economic and social innovation."* The changes that must be systematically monitored are those shown in ***Figure 3.***

Sources of Innovation

INTERNAL SOURCES

- The Unexpected
- The Incongruity
- Changes in Process
- Changes in Structures

EXTERNAL SOURCES

- Demographics
- Social Change
- New Products or Knowledge

FIGURE 3 Sources of Innovation

They are the sources of innovation. Although these sources are all relevant, I will focus on is "changes in process."Changes in process are changes in the way we conduct business, structural changes. To systematically search for creative structural changes, it is necessary to foster high-level debate and evaluation of the technology agenda. High-level officers, I have found, are the primary source of creative thinking. At Penn State, the high-level debate commences with strategic planning. Once a year, as the head of administrative computing, I prepare an administrative computing plan for the following year. This year I also prepared a five year forecast of areas of greatest payoff during the next five years. Penn State's strategic plan is not an idle document. It is reviewed by many before it is approved and even then it is only partially approved. The strategic plan sets the floor for development activities but does not tell the whole story. Beyond the global initiatives of the strategic plan, there is continuing discourse on the priorities assigned to day-to-day work. This discourse is very creative and generally surfaces projects of greatest urgency and opportunity. The participants are highly placed individuals who have an excellent understanding of Penn State as it compares to other Universities. They naturally bring creative, competitive topics to the administrative computing work schedule. The key to unlocking creativity is the cultivation of an environment that encourages creativity to flow.

Another source of innovation that we are monitoring at Penn State is computer aided systems engineering or CASE. This area is especially ripe with creative opportunities. We are moving into CASE slowly because we want to realize it's full potential at each stage in the development cycle before moving to the next. A hasty implementation could result in uneven acceptance and halfhearted participation. We are evolving to our own CASE tool kit in an innovative way. CASE is not a prescription, it is an adaptation. People are beginning to use CASE because they have personal "ownership" of the idea. CASE is happening because the staff is creative enough to want it to. The staff, on its own recognizance, is seeking out novel solutions to our systems development backlog. Once again, it seems we have an environment that is encouraging creativity to flow.

Yet another fruitful source of innovation at Penn State is end user computing. Several years ago we began the "user initiative" which put policies, procedures, tools and security mechanisms in place to encourage end user computing. Today, we are seeing the early payoff of that initiative. Users are coming up with their own creative computerized solutions to doing their jobs better. Their activities are naturally being enhanced by the computer industry and its unending stream of end user computing tools. Again, there is an institutional willingness to cultivate this rich creative end user environment.

Look, Ask and Listen

We are not alone when it comes to innovation. To find sources of innovation, we must keep our eyes, ears and minds open. CAUSE, as one example, is a tremendous source of creative ideas. Our sister institutions are another. To be creative, we must look, ask and listen to the needs being expressed by others. It continually amazes me how simple it is to satisfy some of the most essential needs, if they are understood. It also amazes me how poorly most innovative opportunities are communicated. Before we can create, we must convince others that it is important. We must look, ask and listen to develop advocates for innovative ideas. By listening well, we learn how to shape an idea and make it "right" for the situation at hand. The CASE solution at Penn State is "right" because diverse needs and opinions have embraced its benefits.

As technologists, we must be better than anyone at finding the most creative opportunities. Challenge yourself, sometime, to enumerate creative things that you could do for your institution. I do this routinely. As a personal challenge and test of my understanding of Penn State, I routinely prepare a list of the "five most important" things to be done. The list changes with time. Some things lose their importance. Others assume a greater prominence. To prepare the list properly, I must inquire into the needs of other offices. I must spend time with individuals and managers of those other offices to look, ask and listen to their greatest needs. I must encourage them to brainstorm with me a little. Surprisingly, I find that the five most important things are not always intuitively obvious. They spring forth through creative exchange of ideas. They are typically cross-discipline changes that result from a global view.

Five Most Important Things

- Enrollment Management
- Personalized Correspondence
- AIS Decision Aid (AIDA)
- Electronic Application
- Prospect Management

Just A Little Beyond Our Grasp !

FIGURE 4 Five Most Important Things, Fall 1986

Figure 4 is the list of what I thought were the five most important changes to be made in Fall 1986, one year ago. I am showing them to prove a point. Once I understood that these were important, it was necessary for me to convince others as well. I do not arbitrarily impose my priorities onto our development schedule . . . I try to influence others to change the schedule. The five most important things then become my agenda for lobbying. An innovative idea, no matter how good, should not be implemented if it is not accepted by others. The point that I wish to make is that the five most important changes from a year ago, have been endorsed, and are not in various stages of implementation. The five most important of this year are still under discussion.

Simple and Small

Peter Drucker observes that the most creative ideas are often the most simple. Penn State has a development strategy built around this principal. It is known as incrementalism or "chunking." It is not a major change, intellectually, but it is a major change from the past. Incrementalism is an approach to big system development which intentionally divides them into smaller chunks. Instead of considering all of the things necessary to build a personnel system, for example, we choose to think about those things that will give us the greatest payoff in the next few months. Amazing as it may seem to some, major achievements are possible in a short period of time.

Many benefits derive from the incrementalist strategy. First, it causes us to better consider what changes are worth. If you focus on short term objectives, it is easier to say what is most important. The incrementalist strategy asks "what can we do for you now"; not, "what do you need forever?" My observation, is that with the traditional PROBLEM DEFINITION approach, we tended to focus on global objectives rater than short term accomplishments. We tended to seek ultimate solutions. Expectations were raised and gratification delayed. A dangerous mixture that could, and frequently did, result in conflict. We didn't talk about important things that could be done now nor assign value to chunks that could be realized soon. Instead, we focused on master plans which would likely change during the development life cycle.

You might say the incrementalist strategy is creative because it naturally leads to valuable technological change. The most valuable changes find their way to the top of the list easily. At Penn State, for example, we had to find a new way of managing student progression to their major fields of study. Many majors are limited by the limited faculty and facilities that are available to support the major. The technological solution to this problem came to be known as AMPS -- Advancement to Majors Preference and Selection System. It is a creative solution that gathers the preferences of freshmen and sophomores and then ranks the students that want to enter a common major. The AMPS system has proven invaluable for managing a complex and sensitive problem.

Aim High

The last piece of advice that Drucker offers for managing innovation is to "aim at leadership." This is the key to innovation. Throughout the previous sections, I have explained how we search the sources of innovation; look, ask and listen; and divide our activities into small and simple chunks. But, this is not enough. In addition, we must aim at leadership. We must seek out small, simple solutions that are at the edge of our technology. There are many examples of this at Penn State.

Somehow, we want the very best systems with the most advanced features that are available today. We seek out solutions that are just beyond our grasp and it causes us to strive for excellence. Currently, we are working hard to expand end-user computing within a security framework that controls data access by function and value. The twin values of easy access and tight security controls are diametrically opposed...but we try anyway. We press the limits of fourth generation languages to achieve systems that are easy to build and, at the same time, efficient. We employ fiber optic links for improved terminal response times. We have begun using baluns for transmitting coaxial cable signals across ordinary telephone lines. We are implementing an electronic approval system for handling on-line forms. We have implemented FOCUS to integrate microcomputers into our telecommunication network for file sharing and local data analysis. We are implementing a new Student Longitudinal Research Flat File (SLRFF) for longitudinal analyses of student data. We are implementing a voice response registration system which can communicate directly with students by phone. Each of these innovative activities were initially thought to be beyond our limits but each is now well along the way to reality. Nothing is impossible as long as we strive for it. At Penn State, we aim high!

CONCLUSION

In this paper, I have tried to make the case for implementing technology in a new way, in a way that emphasizes creativity. I believe the basic reason is that our institutions expect us to. There are five simple principles which capture the fundamentals of innovative management:

1. Create or Perish If we don't, someone else will.
2. Five Most Important -- Challenge yourself to enumerate them. The first step of innovative management is to be able to recognize innovative opportunities.
3. Least Size with Greatest Value -- Bigness is not a measure of value.

4. Results Now -- First things first.

5. Beyond our Reach -- Strive for leadership.

The challenge embodied in these principles is tantalizing . . . a challenge summed up in the act of seeking small accomplishments, small accomplishments which can be achieved in a short period of time and, yet, represent bold new strokes in our technological infrastructure. This, then, is creative, or what!

JOINT APPLICATION DESIGN:

Can a User Committee Design a System in four Days?

Diane Kent,
University of British Columbia,

David Smithers,
Computech Consulting Canada Ltd.,

Vancouver, B.C., Canada

JAD (Joint Application Design) is a two to four day structured workshop in which users (including faculty and management) and the project analyst produce a fully documented application solution with enough detail to allow technical design and programming to begin almost immediately. Sound impossible?

At the University of British Columbia we used a JAD for the first phase of our student record system development. The project in itself was an ambitious one - moving from a batch system with arena registration to a distributed system with touch-tone telephone early registration. Thus, using a technique which put a dozen users together in a room for four days to define and document requirements and to complete the functional design seemed like suicide to some.

Using our experience, we will describe how the JAD process works, what results you can expect, how to adapt JAD to an educational environment, and how to ensure that the JAD produces a successful functional design.

INTRODUCTION

Joint Application Design (JAD), originally pioneered by IBM about seven years ago, is rapidly spreading in use by North American organizations, both public and private. In addition to IBM, who have used JAD's on hundreds of their own projects, other well-known users of the technique in the United States include Texas Instruments and the Continental Bank. In fact, executives from these corporations recently shared their experiences with JAD in a James Martin/Deltak video series. In Canada, the technique was recently used by IBM to plan for and design all of the support systems for the 1988 Winter Olympics in Calgary.

At the University of British Columbia we initially used JAD during the first project of many to re-design our student information system. The project itself is an ambitious one - moving from a fifteen-year old batch system with punched cards and arena registration to a distributed system using touch-tone telephone early registration. Thus, using a process which put a dozen users together in a room for four days to define and document requirements and to complete the functional design seemed like suicide to some.

We survived the experience, as you will see, and hope to convince you that if you control the scope, manage user expectations, give the information professionals the right tools, choose the right participants and adapt the technique to a higher education environment, a user committee can indeed design a quality system in four days, using Joint Application Design.

WHAT IS JAD ?

JAD is a technique that allows you to lever one of your scarcest resources - experienced people. It is a structured and intensive workshop involving primarily key users and management, both faculty and staff, who are knowledgeable in the area of the business to be automated, and one senior analyst or project leader. The workshop is sponsored by a committed executive, who understands the JAD process. It is conducted by a leader with special skills, who facilitates and manages the group dynamics of the session. In addition, although they do not directly participate in the workshop, key supporting players such as scribes, automated design tool specialists and a logistics co-ordinator are also invloved. (The individual roles of the major participants will be discussed below.) JAD is intended to analyze user requirements and complete the functional design of a system, replacing the traditional steps of requirements definition and systems design.

In our JAD, we held one four-day workshop which covered the requirements and design of:

- registration (including the dialogue for the voice-response system),
- course scheduling and room bookings, and
- supporting portions of the course catalogue and the facilities management systems

In retrospect, this scope was far too broad. We should have held three workshops, with varying participants, for each of the sub-systems. Also, we should have considered holding separate requirements and design workshops to handle such a broad scope. It is a tribute to both the session leader and the participants in our JAD that the requirements and the design actually did get done in four days!

HOW THE JAD PROCESS WORKS

The basic process can be viewed as a simple system, requiring certain inputs which must be prepared in advance of the workshop, the workshop (or system) itself, and the outputs of the session which are reviewed and fine-tuned as part of the wrap-up, before becoming inputs to technical design and installation. We will focus first on the input side.

Objectives and scope typically come from previous planning work. They are communicated to the team by the executive sponsor at the start of the session, together with any assumptions and constraints.

A Familiarization Guide replaces the traditional requirements step of reviewing present systems and interviewing users. This guide is an informal list of forty questions which ask user participants about planning, receiving, tracking, assigning, processing, recording, sending and evaluating the work they do. In our JAD, these were prepared by holding several small group meetings with key faculty and Registrar's Office staff, with each group completing guides for each of the three systems under consideration.

Pictures of the current process, an item not normally associated with requirements definition, is a valuable input to a JAD. These help participants focus on the reasons why the system is being developed or replaced, and give those who do not have day-to-day exposure to some aspects of the current process a better conceptual idea of the problems. During the preparation for our JAD, the University held its 1986/87 winter session registration, so various JAD participants were sent out trailing friends or relatives through the torturous mass registration process, which takes the average student about five hours to complete, waiting in long lines most of the time.

Prototypes of the new systems may be prepared prior to the JAD. This is typically the case if you do a requirements workshop followed by a design workshop. In our JAD, although we did requirements and design in one workshop, the previous planning process provided sufficient detail of the requirements to allow the support team to build a prototype in parallel with other preparation tasks. This prototype proved invaluable during the session and was part of the reason why such a broad scope was successfully covered in one JAD.

"What others do" encourages participants not to re-invent the wheel. We were able to draw on the experience of the ever-increasing number of universities and colleges who have implemented telephone-based early registration. In particular, when the dialogue between the student and the system was designed, the team reviewed the dialogues of the University of Alberta and Brigham Young University, using these as a starting point for our system.

What results or outputs can you expect from a JAD session?

User or functional design specifications, including the benefits of developing the new system, are the main output. These ought to include: process models, data models and a data element dictionary; report, screen and form layouts; and a prototype, either automated (preferred) or on paper. Our JAD, for example, produced over 200 data elements, 45 screen layouts and 17 reports.

Issues are another important output from a JAD session. If you have the right participants, a large number of issues will be resolved in the session itself. However, the remaining issues will have to be assigned to someone for resolution by a specific date. In a higher education environment, a larger number of issues usually remain unresolved after the session, due to the decentralization of the decision-making process. We had 35 such issues identified in our JAD session.

A structured review session , sometimes called Joint Application Review (JAR) is the last step of the JAD. In our case, the JAR was held one month after the JAD, lasted one day and involved all of the original participants. Its purpose is to review the functional design and prototypes, and to resolve as many as possible of the issues left unresolved at the end of the JAD.

The inputs, the outputs and the JAD session itself can be effectively *levered* through the use of automated design, documentation and prototyping tools. Such tools replace voluminous paper specifications and prototypes, making revision and updating easier; allow reaction to live screens; and increase the rigour of the design by using cross-checking facilities. In addition, structured thinking by all participants can be increased by using Computer Assisted Software Engineering (CASE) tools, which demand that data elements and processes be entered in a structured top-down or bottom-up fashion.

BENEFITS OF USING JAD

As mentioned earlier, the JAD technique is rapidly spreading in use in North America, primarily due to its benefits. The benefit most often mentioned is that the technique can reduce the elapsed time for user requirements and design by up to 40%, by consolidating these activities into several days. What JAD may not do, especially the first few times you use it, is reduce the overall effort (person-days) for these activities. Other key benefits include:

- An increase in productivity of the design team, resulting from the use of dedicated resources over a short period of time, in contrast to other techniques which use fewer, part-time resources over a long period of time.

- Improved design quality and value to the organization, since most people who take part in the session are from the departments who will use the system. High-quality solutions, designs which are functionally complete and the resolution of conflicts in the operational requirements of different users will also follow from a JAD. This, in turn, will help reduce maintenance costs.

- Committment, enthusiasm and consensus between users and information systems professionals, resulting from a user-driven design which not only meets users' needs, but is also politically acceptable.

- Removal of the analyst or project leader from the impossible role of resolving conflicts on user issues, since these are identified and resolved by the users themselves in the JAD session.

- A highly structured environment in which users can develop "computer literacy" and systems professionals can develop a "business understanding" in a relatively short period of time.

OTHER USES OF JAD

Although originally developed for design, JAD has now also been successfully used in other stages of the systems development life-cycle. Application or project planning is actually part of the original IBM technique and is called JAD-Plan or Joint Requirements Planning (JRP). A JAD-Plan workshop is intended to precede one or more design workshops and results in high-level documentation for the entire application or project, including definition of scope, business objectives, overall systems requirements and a schedule and plan for the JAD design sessions themselves.

At UBC, we have successfully used a modified JAD planning technique to hold a series of workshops with managers in the Food Services department to develop an information systems plan for campus food services. Early in 1988, we plan to use JAD for our Human Resources system planning. In addition, since we are reasonably sure that a large part of the system will be a package, we will have our first opportunity to use the JAD design technique for package selection and configuration.

Other organizations have used JAD techniques for Information Resource Planning, Strategic Planning, identifying office automation requirements, and systems maintenance.

While the JAD technique in itself can be used effectively in almost all stages of systems development, greater benefit, or leverage, if you like, can be gained via integration with other tools and techniques. We have already discussed the benefits of automated documentation and prototypes. If these can be linked directly to application generators, then the acceleration of the design stage can be duplicated in the programming stage. Further, once the system is in production, maintenance by regeneration through these tools will help protect the benefits gained in the earlier stages of development. In fact, if you can use JAD and an integrated set of tools right from the initial stages of strategic planning through to maintenance, then you will be in the forefront of technology and will be able to develop quality systems in a shorter elapsed time.

It is only through this integration and acceleration of all phases of systems development that you can maintain the design quality and the user committment and enthusiasm built by the JAD design sessions. This has been a particular problem at UBC. We have a 4GL and other good development tools, but they are not linked to the automated design tools we used in the JAD, nor do we have an application generator for program development. Hence, we reverted to "classical" techniques for technical design, programming, and testing, which left a long elapsed time between the JAD and implementation. Fortunately, the academic policies and procedures which must be changed to accomodate an early registration system also took a long time to develop and approve, so the longer development time has not been entirely focused on the information systems group.

SELLING THE JAD TECHNIQUE

Selling the JAD technique usually requires a "champion" from any one of the participant groups (typically Information Systems) to lobby with management and executives for the use of the technique. The benefits of JAD, particularly the reduced elapsed time for design and the improved quality of resulting systems, are effective in selling this approach to senior management. Our champion was a newly-hired project leader who came to us via the local telephone company where the technique is used extensively.

Once the executives and sponsoring management are "sold", JAD participants are identified and their availability for the session is arranged. The normal approach is to go through the organizational heirarchy, making arrangements with the department heads, deans or vice-president. While this works well with staff participants, the approach fails when used to arrange for faculty members' participation. We found that it is much better to approach the faculty members directly and let them decide the conditions of their participation and inform (or not inform) their department heads and deans.

One of the biggest obstacles standing in the way of selling JAD is people-resistance. This resistance will come from all groups, but will be strongest in the Information Systems group. Visible executive and senior management support, together with participant training, will normally help overcome this resistance; however, this does not seem to work well with faculty members. Therefore, it is important that the executive sponsor be a senior academic administrator with considerable credibility both as an academic and as an administrator. We were fortunate that our sponsor, the Associate Vice-President for Academic Services, had been Dean of the Faculty of Science and has 35 years of experience at the University. When he talked, participants listened!

Lest you believe that a strong executive sponsor is all you need, a few words of caution about selling JAD are in order. Expectations about what will result from the JAD must be carefully and constantly managed. For example, if implementation of the system is dependent on funding which will not be confirmed until after the JAD (as might often be the case in public higher education institutions), then participants should be clearly informed of this by the executive sponsor at the start of the JAD. Participants should be warned not to feel that their effort will be a failure if funding is not approved, since their continued committment and enthusiasm is often enough to obtain funding even if it is not immediately available.

A second expectation which must be managed is the scope of the system to be delivered in the first phase. JAD participants are encouraged to be creative and even wishful in their thinking; however, they must realize that some of their good ideas will not be implemented until later phases, due to budget, schedule or even technical constraints. If this expectation is not well managed, it can result in ill-will between participants and the project manager who is usually under budget and schedule pressures. All concerned must understand the project management triangle.

You now know what a JAD is, what it can do for you, and how you can sell the idea in your institution. Next, you need to know how to get it organized.

ADAPTING JAD TO AN EDUCATIONAL ENVIRONMENT

In a university you can plan the most logical, best orgainized system, with a great cost-benefit, implement it using the latest technology and methodology and still find that the system is a failure. JAD, we believe, can help you avoid this fate, if you learn to adapt it to the educational environment. There are three areas in which this adaptation is important.

Getting the JAD Organized

A typical 3- or four-day JAD session will take at least six weeks of preparation time. In a university, this could take even longer. How quickly can you select the project to use JAD on? How many committees have to approve this? Once you have the project approved, how quickly can you line up a meeting with the vice-president who is going to be the executive sponsor? ("Oh, I'm sorry, I'm going to be away for the next two weeks doing research at the end of the Nile" is an answer you are likely to get.) Then, having identified the project and the sponsor, how quickly can you get a room with the right audio-visual and computer communications facilities? ("What do you mean all these rooms are booked for the whole term and I can only use them during Christmas vacation? It takes how many months to install a computer line?") This is all before you have even begun the six-week process of completing the familiarization guide. The message here is: don't start unless you are well prepared and have the right tools in place.

The JAD Team

Next, there is the question of the participants. The JAD guidelines tell you that the team should be composed of the business experts who either have the authority, or have been delegated the authority, to make decisions regarding both the system and the business objectives right in the JAD session. To select such a team, you must understand the culture of your organization. Naturally, you will have a committee to help you select the JAD team. You will describe the JAD process at length and end by telling them that you only want six people. You will then roll your eyes in horror and disbelief when they suggest twenty, and reluctantly let yourself be persuaded to accept nine or ten. One key to success is keeping your JAD team small.

In many univeristies and colleges, who you exclude is even more important than who you include. Do certain faculties believe that they have veto power over anything you do in a certain system? Is one dean much more vocal than the others? Should every faculty be represented? If they are not, what is the risk? If they are, can they reach ever reach consensus? These are questions which you must be prepared to ask and to answer.

Even more important in higher education is the participation of faculty members themselves in the JAD. You will certainly get asked by one dean if faculty have time for such frivolity. The answer, of course, is yes, but how do you reconcile this with a faculty member's teaching responsiblities and still get the full-time committment you need? At UBC, we developed a *buddy system* , which paired faculty members, so that one could attend the JAD while the other was teaching.

Being aware of these potential problems and being creative in solving them will help you ensure that the system gains political acceptance as well as technical acceptance.

The other member of the JAD team who must be selected carefully is the JAD session leader. You will need a person who is a good communicator and negotiator, but most importantly a good listener. He or she must also be able to control a group, encourage creativity and, where necessary, use the power of persuasion effectively. Some experience as an educator will also be valuable. In addition, this person requires technical skills in the areas of data modelling, data flow techniques and system design.

Particularly important in a distributed system, such as a registration system, is a leader who is seen as neutral. A great deal of compromise is needed to design a successful system in such a short time, and thus the leader cannot appear to favour a particular user department or the information systems group.

So where do you find such a renaissance man (or woman)?

Many of the organizations who use JAD extensively have full-time staff who are well trained as JAD leaders. Most colleges and universities will not have such a person; and, if they did, somebody with such a high profile in the orgainzation would be in such demand that he would be out of the job in three months. What UBC and others have done is to find outside experts or consultants and use them to run the first few JAD's, while training one of the local staff members in the process. As an additional benefit you may find that consultants can offer advice on structuring the JAD session, system design standards and concepts and approaches which have worked well in similar systems. As the technique is used more widely, you may find that you can *trade* session leaders with other institutions, especially to establish the leader's neutrality.

Having finally organized the JAD and assembled the team, you will have to turn your attention to the JAD session itself.

The Jad Session

One of the most difficult tasks in the session is controlling the scope. Three days go by so quickly that if your leader is not able to keep the team within the scope you will find that the job is only half finished. Many of the participants will be so excited about being asked, for the first time, to design their own system that they will attempt to explore and resolve every possible problem. Also, the leader must not allow exceptions and rare problems to shift the focus from the main issues.

One of the ways to keep within scope, and at the same time keep the energy level of the session high, is to structure the day for variety. Concentrate on one area of the system for several hours, taking it only to a partial conclusion, then switch to a new area, returning later to finish the first area and handle the exceptions. However, if this approach is to work well, you will need a good set of minutes.

Taking minutes for a JAD session is an art, not a task assigned as punishment. You will refer to these minutes repeatedly during the session and find that they are a source of information and decisions in all subsequent phases of the project. The rigour with which these minutes have been recorded will be vital to the success of the design effort. In fact, in a JAD you will need at least two scribes - a user scribe, who documents issues, policies, decisions, and procedures; and a technical scribe who handles the data model, data flows, prototypes etc. Of course, the more you can automate the tasks of both of these scribes, the more successful your JAD will be.

Finally, the layout of the JAD room should be carefully considered to minimize distractions and enhance the productivity of the session. Audio-visual and computing equipment should be used to advantage, but should not be so obtrusive or extensive that it intimidates the participants or becomes a distraction. More importantly, you will want to allow some observers (especially at the first JAD) for public relations, training and for broadening the exposure of the system and the process. You must insist on a limited number of observers and a strict rule of silence, while positioning the observers' seating so that they may come and go without unduly disrupting the session.

The JAD session is now organized and ready to begin. What can you do to ensure that this committee designs a horse rather than a camel?

ENSURING A SUCCESSFUL FUNCTIONAL DESIGN

Our experience has shown that there are four areas on which you should concentrate to ensure a successful functional design:

- the use of prototypes
- focusing on what, not how
- the systems environment
- life after JAD

We developed prototype screens before the JAD session and used these as a starting point to focus the discussion. This approach has both strengths and weaknesses. As information systems professionals we know that users generally do not know what they want until they have seen a version of it and worked with it. Prototypes can clearly fill this need. However, we must also beware of the infamous analysts' disease: "The problems I like are the ones which fit the solutions I have". In other words, prototypes developed before the final requirements are known can inadvertently focus on the strengths of the analyst and the tools, causing users to accept what they see rather than assess the requirements critically. You must, therefore, convince the analyst to design prototypes which have known flaws, so that the users will criticise the prototype, suggest improvements and begin to *own* the system.

The session leader must also warn the analyst not to suggest corrections to the prototype too quickly. The most difficult concept the analyst must learn is that the users have to take the time to design the system themselves. Many analysts are like Saint Bernards, rushing to the rescue of the users and smothering them with solutions before ascertaining whether or not they really need help.

One of the other difficult tasks for the session leader is to keep the users focused on what they do, rather than how they currently do it. Instead of saying, "I have to put the course cards in three different piles, one for the majors, one for the engineers and one for everybody else", the session leader has to teach the user to say, "I need to be able to reserve a certain number of places in a course for various groups of students". A prototype screen, introduced at an early stage and based on the current system's three piles, may result in the users forgetting to ask the question, "Are there any courses which need to reserve places for *more* than three groups?"

In developing prototypes and holding a design workshop, it is important that the session leader and the people doing the prototyping have a good knowledge of your existing systems environment. If you have screen design standards, insist on their use. If you do not have such standards, put them in place **before** the JAD begins. This will prevent time being wasted in the session discussing whether the screen name should be five characters or six random numbers, and whether it should be in the upper left-hand corner or the right-hand corner. The design will also proceed faster if the leader has a clear vision of what the whole system should look like and how it will interact with the users.

After the design session, let the professionals who know the capabilities of your particular software polish the design and optimize it from a programming and performance perspective. Then, hold a design review, in which the systems professionals explain the changes they have proposed and ask the users for approval. It may be a humbling process for the systems people and lesson in reality for the users, but it is well worth the time and the effort.

Now, having finished the enormous task of organizing and actually running a JAD, you turn your creation over to the systems development staff for programming. For a few weeks, the users who made up the JAD team feel relieved that it is all over and become immersed in their jobs, catching up on all the work which was left on their desks. However, they eventually emerge and begin to ask, "Is there life after JAD?" The answer is, yes!

The team can still play a role during the systems development stage, and, in fact, is a resource which should not be lost. Despite the success of the JAD, design is never finished. In a large organization, like a university, you should have the JAD team conduct a *prototype tour* , so that all departments have an opportunity to provide input to the system. This tour, if properly managed, will result in a broad base of users committed to the system, rather than just the small group involved in the JAD. At the same time, the team should be using the prototype and the JAD minutes to develop user documentation, test cases and a training plan. After all, it is their system, so why would they want to let programmers write documentation for them?

As programming progresses, new requirements are identified, programmers suggest better ways of doing things and users themselves may have new ideas. Re-convening the team periodically to review changes in the design is an excellent way to continually improve the quality of your system. At the same time, the team members can be assigned to follow up issues raised at the session which could not be resolved at that time. At UBC, we established an Advisory Committee, with representatives from each faculty, to deal with policy, procedures and implementation issues on an on-going basis, using the JAD team as key members of that committee. By being involved in these two activities, the team will continue the momentum and the committment built during the JAD, and, hopefully, spread the word to others in the organization.

CONCLUSIONS

Can a user committee design a system in four days? Yes, but in our experience you must pay careful attention to five areas. First, keep the scope of each session as narrow as is practical, even if this means holding several two-day sessions rather than one four-day session. Second, learn to manage user expectations, before, during and after the JAD. Third, give the information systems professionals the tools they need to make a JAD effective. Technology is now available to handle documentation, data modelling, data flow diagraming and prototyping, all of which will significantly reduce systems development time. If you do not have these tools or cannot get them, then you may not want to use the JAD technique. Fourth, choose the JAD team and leader carefully. The wrong users, even with a good leader, will not develop a quality system. Finally, don't be afraid to take the technique and adapt it to an educational environment.

PAPER PRESENTATION ABSTRACT

Title of Paper Presentation:
Making It Happen Without Appropriation

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University of South Carolina

Summary of Paper Presentation:

Higher Education is being challenged by budget crises involving substantial reductions while at the same time technological services are being asked to increase support in all areas: increased access, improved response, more capacity, expanded consulting, a wider range of software, micro's and terminals, courses on technology and on-going upgrades in all areas. One can either wait for appropriation and/or allocations to increase resources or initiate a course of action which provides for growth and expansion by developing sources of revenue and by use of management practices which meet institutional objectives but eliminate those services where limited support and usage deny justified expenditure.

Outline of Paper Presentation:

I. Background -
  A. Funding Status
  B. Student to Access Ratios
  C. Growth Data - Volumes/Applications
  D. Impact on Communications
  E. Microprocessor Influence
  F. Literacy Issues

II. The Cost Center Approach -
  A. All Operative Areas are Cost Centers except one overhead entity - Vice President's Office/Business Operations.
  B. Cost Centers may be all or part revenue or appropriated funds.
  C. Centers grow by increased appropriation and/or revenue.
  D. Lack of growth of funds means lack of support.
  E. Decrease of funds, either appropriation or revenue means reduction in staff/services.

III. The Consequence of the Cost Center Approach -
  A. Increased Staff, Services and Resources.
  B. Expenditure Budget is Three-Plus Times the Appropriation.
  C. Growth Opportunity is an Incentive.
  D. Appropriation Stagnation/Reduction is Less Traumatic.

IV. Examples of Revenue Sources -

Slides will be used to portrait organization and to illustrate changes and benefits.

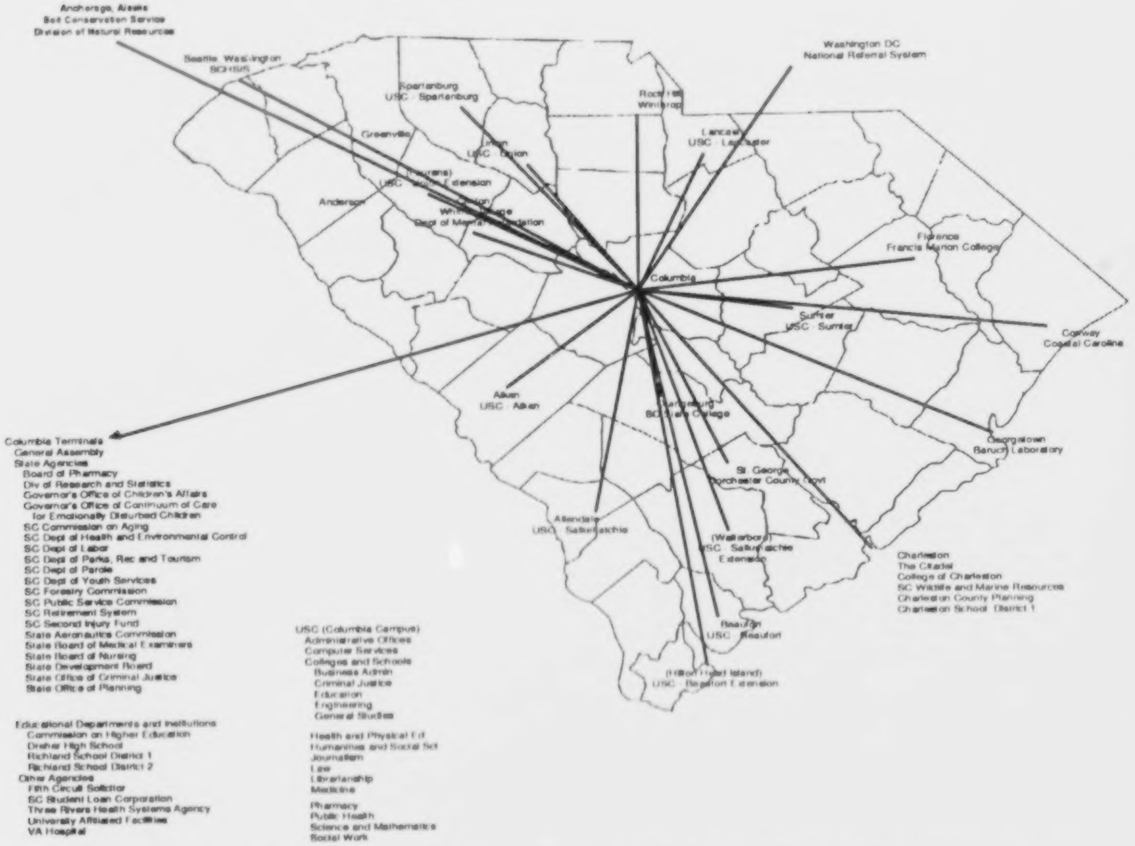
MAKING IT HAPPEN WITHOUT APPROPRIATION

By: Robert E. Roberson

Colleges and universities whether private or public, large or small and generally without much regard for geography face increasing costs, decreasing budgets and the possibility of substantial increases in tuition. An area significantly impacted by this situation is the area of providing technological services which for purposes of this presentation include computing, communications, software availability, application development, staff, hardware maintenance and training. Hopefully, any other areas of support can be adapted to the intent of this paper.

The simplest way to illustrate the point of this paper is to make comparisons between what was and the way it is today and to communicate the methods used to achieve the change.

In 1987, as in 1981, the University of South Carolina consists of a multicampus environment with approximately 35,000 in head count and those campuses blanket the state.


Anchorage, Alaska
Soil Conservation Service
Division of Natural Resources
Seattle Washington
SCHSIS
Spartanburg
USC · Spartanburg
Greenville
Union
USC · Union
(Laurens)
USC · Union Extension
Anderson
(Clinton)
Whitten Village
Dept of Mental Retardation
Rock Hill
Winthrop
Lancaster
USC · Lancaster
Washington DC
National Referral System
Columbia
Florence
Francis Marion College
Sumter
USC · Sumter
Conway
Coastal Carolina
Aiken
USC · Aiken
Orangeburg
SC State College
Georgetown
Baruch Laboratory
St. George
Dorchester County Govt
Allendale
USC · Salkehatchie
(Walterboro)
USC · Salkehatchie
Extension
Charleston
The Citadel
College of Charleston
SC Wildlife and Marine Resources
Charleston County Planning
Charleston School District 1
Beaufort
USC · Beaufort
(Hilton Head Island)
USC · Beaufort Extension
Columbia Terminals
General Assembly
State Agencies
Board of Pharmacy
Div of Research and Statistics
Governor's Office of Children's Affairs
Governor's Office of Continuum of Care
for Emotionally Disturbed Children
SC Commission on Aging
SC Dept of Health and Environmental Control
SC Dept of Labor
SC Dept of Parks, Rec and Tourism
SC Dept of Parole
SC Dept of Youth Services
SC Forestry Commission
SC Public Service Commission
SC Retirement System
SC Second Injury Fund
State Aeronautics Commission
State Board of Medical Examiners
State Board of Nursing
State Development Board
State Office of Criminal Justice
State Office of Planning
Educational Departments and Institutions
Commission on Higher Education
Dreher High School
Richland School District 1
Richland School District 2
Other Agencies
Fifth Circuit Solicitor
SC Student Loan Corporation
Three Rivers Health Systems Agency
University Affiliated Facilities
VA Hospital
USC (Columbia Campus)
Administrative Offices
Computer Services
Colleges and Schools
Business Admin
Criminal Justice
Education
Engineering
General Studies
Health and Physical Ed
Humanities and Social Sci
Journalism
Law
Librarianship
Medicine
Pharmacy
Public Health
Science and Mathematics
Social Work

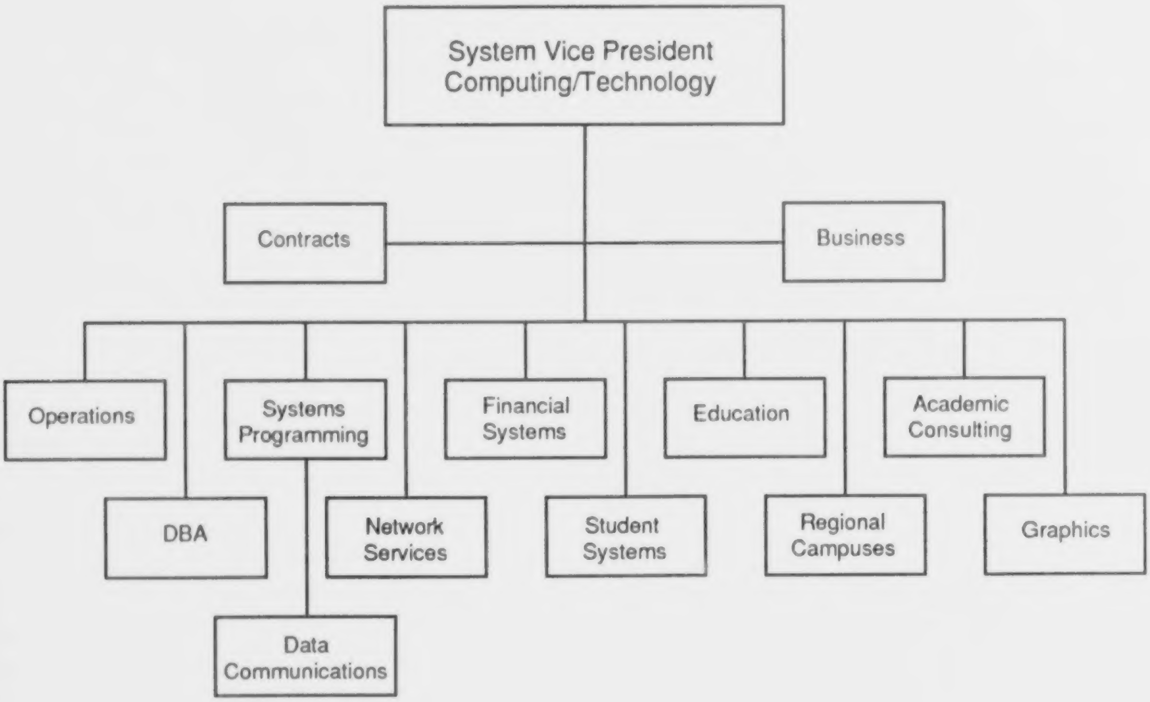
Note: Areas where technical services are provided beyond the University are annotated.

The parenthesis under some of the two year campuses such as Union with (Laurens) indicates a satellite program in areas near the campus in question.

In 1981 the only computing power in the University system was resident at the Columbia campus, with all other sites having terminals and in most cases remote job entry stations and printers available for both academic and administrative computing support. Even on the Columbia campus with almost twenty three thousand students the only computing power existed in Computer Services with a four MIP AMDAHL V6-2, accessed by RJE stations and terminals from various labs and administrative offices on the USC campus. (There was one VAX 11/780 in Engineering dedicated to a funded research project.)

There were also approximately one hundred terminals and six RJE stations in state agencies which also accessed the AMDAHL V6-2. The usage by these agencies comprised almost 50% of the usage of the in place processor and generated approximately $900,000 a year in revenue which supplemented the appropriated budget which was $4.5 million for a total of $5.4 million as an expenditure budget. The long term indebtedness of the center was approximately four million dollars.

The staff consisted of 122 full time people organized as follows:


System Vice President
Computing/Technology
Contracts
Business
Operations
Systems Programming
Financial Systems
Education
Academic Consulting
DBA
Network Services
Student Systems
Regional Campuses
Graphics
Data Communications

One of the critical issues requiring attention and improvement was the ratio of students to access devices, whether terminals or micros. Even in 1983 that ratio was 415.8 to 1.

The turnaround on the main processor was indefensible and the frustration of users was apparent every day.

South Carolina is funded on the basis of a formula lump sum budget process. In the last seven years the University has not been fully funded and in 1987 the funding level is at 86% of the formula.

In fact, for FY 87-88 the appropriated technology budget under the System Vice President for Computing Technology was reduced by $482,000 from its 86-87 base, as were all other units of the University.

Against this background the demands for increased service, more capacity, new software packages, higher speed communications, never ending requests for more terminals, micros and research computing reached new heights.

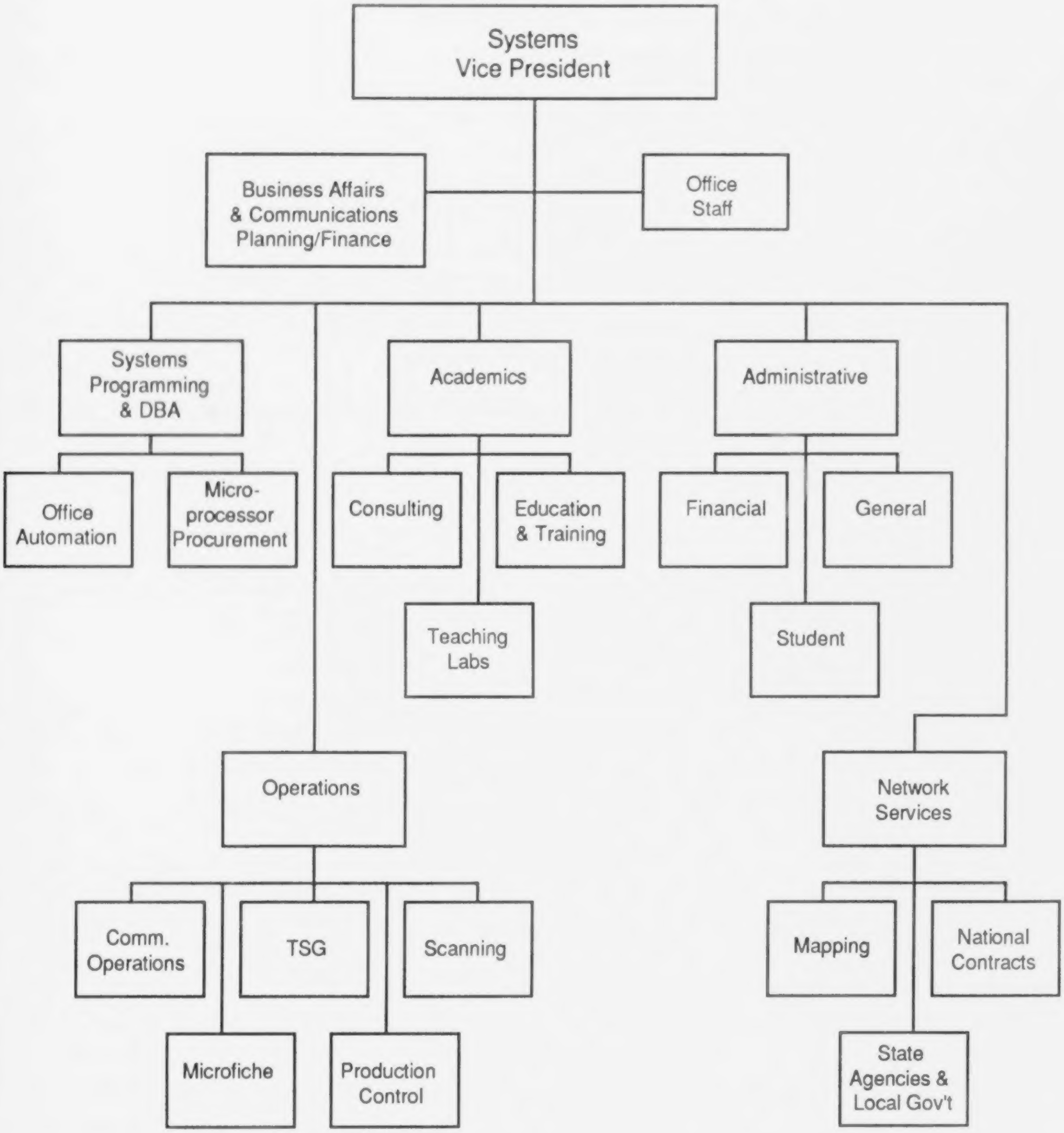
None of these actions were simultaneous, but over time the combination of such actions resulted in a dramatic change in our ability to respond to the needs of our user constituency. What did prevail was a conscious and deliberate management approach on which actions were based and on which decisions were made.

Very concisely the approach included these beliefs:

1. The demand for technology will always exceed the budgeted resources.
2. Public service is a legitimate role of an educational institution and such service can be provided economically and to the advantage of the supplier.
3. The technical component of the institution must be managed like a business, including incentives to stimulate growth and necessary reductions where "unprofitable" enterprises are clear.
4. As with all businesses there are needs for "seed" money and the opportunity to invest must be recognized.
5. The operating units within the institution's technological area must manage with flexibility and be permitted to use entrepreneural techniques where appropriate.
6. Each unit of technology is viewed as a "cost" center charged with fulfilling its mission, growing against need and supplementing its cost center appropriation with revenue.

The above guidelines for operation emerged in 1982 and have grown and evolved in practice with today's environments. Before addressing specific actions let me compare where we are today to the 1981 status previously noted.

Organizationally we now look like this:


Systems
Vice President
Business Affairs
& Communications
Planning/Finance
Office
Staff
Systems
Programming
& DBA
Academics
Administrative
Office
Automation
Micro-
processor
Procurement
Consulting
Education
& Training
Financial
General
Teaching
Labs
Student
Operations
Network
Services
Comm.
Operations
TSG
Scanning
Mapping
National
Contracts
Microfiche
Production
Control
State
Agencies &
Local Gov't

The staff is now 190 people.

The appropriated budget is 6.5 million which includes the absorption of communications and its associated $1.3 million. Therefore, over the last six years the appropriation has actually increased from 4.5 million to 5.2 million or 15.3%. To the point of this presentation, our expenditure budget runs from fifteen million a year and higher and our capital indebtedness has gone from four million to almost nine million with an annual cost of over $3.5 million.

Some of the key actions that provide us this environment have been:

1. In 1982 all elements of the division were costed to establish billing rates. The costs were inclusive of all expenses, eg: capital, maintenance, staff, etc.
2. All fixed contracts for external usage were eliminated in favor of billing on the basis of usage.
3. Cost center budgets for operating units were established over the entire operation with over 50% of the expenditure budget as revenue based.
4. Units unable to meet budget figures were reduced in expense (size) and frequently merged into other units.
5. Marketing of technical services was embraced with vigor to include state and local government in South Carolina and other state and federal contracts. Currently, services are in place for federal systems, four other states and over seventy five agencies internal to South Carolina.
6. A policy was established that for other than a university system microprocessor programming was not supported. It could be provided as part of service contracts for local applications.
7. Long distance billings are handled by the communications component at rates less than commercially available, but beyond cost of providing such services.
8. A microprocessor contract was implemented for resale to educational entities in the State. Over the last four years over $12 million in sales have occurred.
9. Technical training/education is offered to any state agency at a fee per course.
10. The typewriter repair service was absorbed and made a part of an existing maintenance group which bills at a lesser rate than the available maintenance contracts.
11. A student fee was implemented to generate $1.5 million a year for obtainment of instructional equipment.
12. Long term financing of equipment, predicated on a growing revenue base, allowed substantial increases in technological equipment without budget increase.
13. Over fifty-five private lines access our resources with end users being responsible for costs. A bid was issued which resulted in an overage savings of 38% per line and a benefit of 15% to the data center.
14. We are now in the process of preparing to bid cable television in the dorms. When completed with student rates offered at less cost than local cable companies it will more than pay for itself and provide 360 megahertz of data communications for broad band purposes to the University.

15. Until 1984 most terminals, controllers and printers were purchased by departments. As with other types of equipment such as 5520 shared logic systems and remote controllers, the computing technology area established ownership of the controllers and processor units with terminals, micros and work stations the responsibility of end users. In place items were funded centrally; all new devices since 1984 result in end users "buying" a share of the control devices and a share of the maintenance.
16. Maintenance on micros, terminals, controllers, typewriters and much of the communications equipment other than the PBX itself, is done by local technical staff.

The consequences of the above issues have been substantial.

- Revenue has grown from $75,000 a month to in excess of $450,000 a month.
- External usage has dropped to 26% of usage but has risen to at least 50% of the expense budget.
- One-third of the programming staff is directly supported, including fringe benefits by contract programming and software maintenance contracts.
- The ratio of students to access devices is now 18.6 to 1 (students to terminals and micros).
- In addition to two 3081 processors, a Vector processor and a VAX 11/780 centrally located, the University posesses six other VAX 11/780's in Engineering and Science and Math, an IBM 4381 in Business Administration, plus a number of smaller miniprocessors (at least twenty five).
- Within an eighteen month period, July 1986 - January 1988, two writing labs of twenty-four micros each and a ten station graphic lab will have been installed in Journalism. A fifty workstation lab is being put in place in Humanities and Social Sciences for teaching English and a graphic lab of twenty work stations for geographic needs in the Social Sciences.
- To encourage faculty to develop technological enhancement for infusion in disciplines is a need we must all address. An example of how the management theory herein proposed assisted is as follows:

This past summer three levels of interaction were offered to faculty, ie: elementary, advanced and sophisticated course development. Subsequently, grants were awarded to limited numbers and over 75 faculty participated. The courses were fee based. Since that venture four faculty have obtained private funding to develop course materials making use of technology. Our staff support these activities in various ways and revenue is derived from direct payment, royalties or a combination thereof.

The above are only a few examples of substantial gains accomplished particularly in the last forty-eight months, which incidentally does not include a ten node 8700 line locally managed AT&T PBX environment. The latter and all other upgrades have been accomplished in a period when the appropriated budget is at a level in fiscal year 1987-1988 that is lower than it was in 1984-1985.

There are management and procedural issues which become critical to the success of this approach.

Constant and detailed interaction must occur between the cost center directors. This is pertinent for particularly two reasons. It is not reasonable or beneficial to have the operative areas behave as fiefdoms. It must be viewed as an organization of components, properly managed and "self sufficient" but all components must succeed if we as a whole are to succeed. Part of the interaction involves analysis of status by cost center which involves the sharing of data such as the following reports:

1. Long Distance Status - Year to Date. (July through October, 1987)

EXPENDITURES	MONTHLY	CUM. TOTAL
TSI (TOLL)	$81,324.38	$202,430.60
TSI (MEGALINKS)	$3,175.20	$6,160.00
OTHER:	$	$
	$	$
TOTAL EXPENDITURES	$84,499.58	$208,590.60
REVENUE:		
ADMINISTRATIVE BILLING	$94,709.08	$315,575.08
STUDENT BILLING	$81,657.13	$164,82.15
CREDITS	$	$
DEBITS	$	$
TOTAL REVENUE	$176,366.21	$480,447.23
PROFIT/LOSS	$91,866.63	$271,856.63
TECHNICAL SERVICES (5%)	$4,593.33	$13,592.00
ADMINISTRATIVE SERVICES (5%)	$4,593.33	$13,592.00
COMMUNICATIONS (90%)	$82,679.97	$244,672.63

2. Cost Center Status Year to Date. (Revenue)

COST CENTER	DESCRIPTION	86-87 REVENUE	CURRENT REVENUE	PROJECTED REVENUE Y-T-D	ACTUAL REVENUE Y-T-D	% OF QUOTA
C001	VICE-PRESIDENT	$213,684	$2,390	$35,614	$4,552	13%
C101	ADMINISTRATION	$497	$84	$83	$164	198%
C102	ADMINISTRATION	$2,964	$193	$494	$539	109%
C108	ACADEMIC	$6,253	$775	$1,042	$1,544	148%
C110	ADMINISTRATION	$13,228	$1,577	$2,205	$3,190	145%
C113	AUDIOVISUAL	$453	$0	$76	$0	0
	TOTAL	$237,079	$5,019	$39,513	$9,989	25%
C002	OPERATIONS	$38,205	$2,673	$6,368	$5,343	84%
C003	OPERATIONS	$5,666	$1,218	$944	$1,856	197%
C004	MICROFICHE	$94,457	$3,113	$15,743	$9,168	58%
C007	SCANNING	$5,713	$1,732	$952	$2,460	258%
C106	TECH. SUPPORT	$135,536	$9,601	$22,589	$40,963	181%
	TOTAL	$279,577	$18,337	$46,956	$59,790	128%
C105	ACADEMIC SERVICES	$48,127	$3,416	$8,021	$6,812	85%
C111	ACADEMIC-MICRO	$4,835	$1,039	$806	$1,039	129%
C330	ACADEMIC SERVICES	$530,712	$35,793	$88,452	$75,825	87%
	TOTAL	$583,674	$40,248	$97,279	$83,676	86%
C114	BUSINESS	$15,126	$935	$2,521	$935	37%
	TOTAL	$15,126	$935	$2,521	$935	37%
C112	ADMIN.-MICRO	$88,387	$4,145	$14,731	$8,287	56%
C115	FINANCIAL SERVICES	$0	$0	$0	$0	0
C116	GENERAL ADMIN.	$77,148	$0	$12,858	$5,835	45%
C117	STUDENT INFO.	$7,959	$203	$1,327	$571	43%
C118	ADMIN. SERVICES	$0	$25	$0	$25	
	TOTAL	$173,494	$4,373	$28,916	$14,718	51%
C107	DIGITAL MAPPING	$114,137	$26,061	$19,022	$54,404	286%
C300	NETWORK SERVICES	$90,294	$3,811	$15,049	$8,400	56%
C310	NETWORK SERVICES	$212,725	$30,284	$35,454	$107,684	304%
C320	NETWORK SERVICES	$532,857	$46,211	$88,810	$95,662	108%
C325	NETWORK SERVICES	$447,050	$21,675	$74,508	$52,293	70%
	TOTAL	$1,397,063	$128,042	$232,843	$318,443	137%
C005	SYSTEMS & DBA	$39,589	$1,415	$6,598	$1,858	28%
C006	SYSTEMS & DBA	$675	$60	$113	$75	66%
C109	OFFICE AUTOMATION	$41,966	$2,676	$6,994	$8,453	121%
	TOTAL	$82,230	$4,151	$13,705	$10,386	76%
	MISC. REVENUE ADJUSTMENTS					
	TOTAL					
	OVERALL TOTALS	$2,768,243	$201,105	$461,373	$497,937	107%

3. Status of Long Term Financing.

BEGIN	END	MONTHLY	FY1987	BALANCE(1/87)
Jan-84	Dec-90	32,387	388,650	1,613,911
Jan-84	Dec-88	2,698	32,376	64,752
Aug-84	Jul-89	763	9,156	23,653
Jul-85	Jun-88	4,396	52,752	79,128
Aug-85	Jul-90	38,466	461,592	1,488,552
Sep-85	Aug-89	85,293	1,023,516	2,447,600
Oct-85	Sep-90	2,838	34,056	110,359
Oct-85	Oct-88	25,840	310,080	568,480
Nov-85	Oct-89	36,858	442,296	1,102,691
Nov-85	Oct-90	14,268	171,216	506,135
Jan-86	Dec-90	2,774	33,288	118,303
Feb-86	Nov-88	508	6,096	11,684
Jun-86	May-89	9,938	119,256	264,419
65200	TOTAL	257,027	3,084,330	8,399,667
Jan-85	Dec-89	43,893	526,716	1,447,972

4. Access Ratios - Students to Devices.

SCHOOL	TERMINAL	MICROS	TOTALS	FTE 86	RATIO STUDENT DEV	CRT'S	FTE 83	RATIO STUDENT DEV
MEDICAL SCHOOL	13	10	23	278	12.1	2	214	107
COLLEGE OF NURSING	4	8	12	356	29.6	0	379	0
COLLEGE OF PHARMACY	10	32	42	215	5.1	0	198	0
HEALTH	22	12	34	426	12.5	0	417	0
HEALTH & PHYS ED	2	0	2	254	127	0	278	0
PUBLIC HEALTH	16	8	24	141	5.8	0	99	0
COMMUNICATIVE DISORDERS	4	4	8	31	3.8	0	40	0
HUMANITIES & SOCIAL SCI.	40	253	293	6323	21.6	13	6213	477.9
ART	0	3	3	294	98	0	286	0
ENGLISH	0	31	31	1178	38	0	1185	0
FOREIGN LANGUAGES	1	4	5	768	153.6	0	768	0
MUSIC	0	1	1	330	330	0	289	0
NAVY	0	2	2	37	18.5	0	41	0
PHILOSOPHY	0	5	5	261	52.2	0	264	0
RELIGIOUS STUDIES	0	0	0	82	0	0	76	0
SBS LAB	10	82	92	0	0	5	0	0

SOUTHERN STUDIES	0	1	1	0	0	0	0	0
THEATRE & SPEECH	0	0	0	233	0	0	213	0
AEROSPACE STUDIES	0	0	0	18	0	0	25	0
ARMY ROTC	0	0	0	18	0	0	18	0
ANTHROPOLOGY	2	3	5	111	22.2	0	126	0
GEOGRAPHY	6	12	18	217	12.1	0	210	0
GINT	3	5	8	668	83.5	0	737	0
HISTORY	0	12	12	844	70.3	0	862	0
PSYCHOLOGY	12	86	98	895	9.1	8	787	98.4
SOCIOLOGY	6	6	12	349	29.1	0	318	0
HSSI	0	0	0	20	0	0	8	0
SCIENCE & MATH	17	134	151	3253	21.5	17	3428	201.6
REMOTE 1	9	44	53	1649	31.1	8	1643	205.4
BIOLOGY				683			669	0
CHEMESTRY				515			584	0
PHYSICS & ASTRONOMY				451			390	0
REMOTE 43	8	90	98	1604	16.4	9	1785	198.3
GEOLOGY				249			345	0
COMPUTER SCIENCE				283			378	0
MATHEMATICS				935			947	0
STATISTICS				137			115	0
APPLIED PROF. SCIENCES	23	31	54	752	13.9	0	1468	0
BUSINESS ADMINISTRATION	40	88	128	2888	22.6	14	2845	203.1
CRIMINAL JUSTICE	6	31	37	168	4.5	0	176	0
EDUCATION	5	30	35	1193	3.4	0	1494	0
ENGINEERING	200	20	220	734	3.3	0	779	0
COLLEGE OF JOURNALISM	4	25	29	287	9.9	0	352	0
LIBRARY & INFO. SCIENCE	3	18	21	135	6.4	0	81	0
COLLEGE OF SOCIAL WORK	1	9	10	232	23.2	0	149	0
UNIVERSITY 101	2	3	5	220	44	0	162	0
LAW SCHOOL	8	2	10	785	78.5	0	770	0
TOTAL	398	706	1104	18245	16.5	46	19125	415.8

Individual cost center directors have the opportunity to prioritize new needs based on their own or some other cost center margin above revenue projections and include positive revenue positions in areas such as long distance billing.

Furthermore, the dependency on revenue to meet expenditure commitments and for new ventures is reviewed from an operational relationship perspective. Which is to say very little occurs where less than two cost centers are not involved in the support of a project. Projects are analyzed in terms of available resources and user benefits and the margin of gain in the revenue stream. In most cases the revenue is shared by multiple cost centers based on a percentage established according to the level of support provided.

The awareness of how our information technology operates has resulted in constant inquiry regarding our services. This not only applies to development and production projects but to the level of assisting in obtaining better rates in areas such as private lease lines for end users. In this particular case end user costs were reduced by as much as 40% and our revenue for that effort was 15% of the savings.

Although a sophisticated billing and accounting system is a prerequisite for this project the benefits are clear.

1. The University has 50% more technical resources available than would otherwise exist.
2. Cost center directors not only manage technology but as well manage their units destiny within the parameters of our goals and missions.
3. The spirit of it is business and entrepreneuralism has established a motivation within groups and individals that translates into "we can grow as much as we want and are not constrained by a lack of funding." (In most cases this expands the opportunity to enhance the magnitude of knowledge in the latest technologies).
4. There are opportunities for economical gains by individuals if projects are undertaken where substantial time and effort is required of staff members' personal time and is over and above his/her regular job tasks and expectations. (This is an identified and negotiated matter before any such efforts). It should be noted, however, that since this was initiated attrition has dropped from about 25% to 12% per annum.
5. The availability of such revenue has expanded the benefits of off-site training, technical conferences and in-house get togethers, all of which contribute to the gains achieved and staff morale.

We are frequently asked, "Why do you do this?" The response is simple. If you do not grow you cannot meet the needs of the institution and it is unlikely you can expand technologically without sufficient funds. With appropriation unequal to the demand we can either wait for additional funding or take the responsibility of supplementing the appropriation in sufficient amounts to accommodate the technical needs. For those of us who have enough funds to meet our needs, we are fortunate. For those of us who do not, this is an example of one course of action. It is demanding, sometimes precarious but is also fun and rewarding for you, your staff and your institution.

PROTOTYPES AND SIMULATIONS AS DECISION TOOLS: INCREASING THE SOFTWARE IMPLEMENTATION SUCCESS RATIO

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ABSTRACT

Implementation of purchased administrative software requires design and decision testing strategies focused differently than in traditional software development projects. Although vendor-developed software may closely match an institution's needs, there are still significant project challenges. Purchase decisions often do not/cannot include rigorous analysis of institutional policy and procedural implications. Successful system integration, within the context of policies and procedures, suggests the need for decision verification tools.

This paper describes efforts to bridge the software-context gap through the use of prototyping and simulations. These design/decision testing approaches were used in a recent student information system implementation. A prototype was used to orient project teams to software capability, to test data base decisions, to bring meaning to the developing product, and to transfer the focus from a technical to user orientation. Simulations helped validate policy, procedural and software decisions and interactions from both the service provider and client group perspectives.

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Tarpon Springs, Florida
December, 1987

Prototypes and Simulations as Decision Tools: Increasing the Software Implementation Success Ratio

INTRODUCTION:

The evaluation and use of purchased administrative software within higher education institutions is an obvious and accelerating trend. Purchased systems have thrived as alternatives to traditional system developments due to increased functionality, data base capabilities, cost-effectiveness and access to more timely solutions. While vendor-developed software may closely match an institution's needs, there remain significant implementation management challenges. Especially problematic is a project's early, and appropriate, emphasis on software product evaluation and selection. Purchase decisions often do not and cannot include rigorous analysis of institutional policy and procedural implications. Successful implementation of a purchased software system depends, therefore, upon its integration within the context of institutional policies, procedures and organizational culture. This requirement suggests the need for design and implementation decision verification strategies which can be systematically applied to validate the impact upon existing and changed policies, procedures and organizational norms and values.

One approach to bridging the software-context gap is through the use of software system prototyping and process simulations. These design/decision testing approaches were used by Saint Louis University in a recent student information system implementation. A prototype was used to promote team members' understanding of the software capabilities, to test design and data base decisions, to bring meaning to the developing system and to transfer the focus from a technical to user/policy/procedure orientation. A simulation, in the form of a complete mock registration process, helped test policies and procedures from both the system development team and user group perspectives.

BACKGROUND:

Saint Louis University is a private, liberal arts institution dedicated to the Jesuit tradition of education. The University, founded in 1818, is the oldest university west of the Mississippi, enrolls over 10,000 students and employs 4,000 full-time and part-time faculty and staff. The University consists of the Frost campus, Medical Center/University Hospitals and Parks College in Cahokia, Illinois. Academic offerings include undergraduate, graduate and professional programs, medical school, law school, Parks College (aerospace and avionics) and affiliated programs in Spain and France.

In 1984 the University began a major effort to upgrade its administrative information systems. New software and hardware systems were purchased and successfully installed into production for financial accounting (July, 1985), alumni/development (July, 1985), payroll/personnel (December, 1985) and student information management (October, 1987). These systems use Information Associates' Series Z (FRS, ADS, HRS, SIS) software running on three Digital Equipment Corp. (DEC) computers (VAX 8530, 11/785, 11/750) linked under a VAXCluster architecture. Over 200 workstations (terminals and microcomputers) are connected to these on-line, integrated data base systems.

IMPLEMENTATION CHALLENGES:

Saint Louis University (SLU) began implementation of a University-wide student information management system (SIMS) in 1986. Papers describing software selection, previously installed systems (FRS, ADS, HRS), project organization and computing implications have been presented at CUMREC85 and CAUSE85. This paper explains how specific design and testing techniques can be used to evaluate and refine implementation plans and decisions as to their impact upon, and interaction with, institutional policies and procedures.

Implementation of a student information system is an institution's most complex computing challenge. It includes multiple components (admissions, student records, billing/receivables, financial aid management, housing, institutional research) and involves more people. It extends data base access and functional responsibilities further into the user community and at an earlier stage than other information systems. The "go-live" process is also more complex due to multiple subsystems. SIMS went live September 24 for the schedule of classes; October 26 for on-line early registration (11 sites, 25 workstations); October 27 for undergraduate admissions (6 other offices followed); November 2 for cashiering; December 5 for tuition calculation and billing; and December 14 for financial aid. SIMS also encompassed three campuses and several academic calendars (semester, trimester, year).

The SIMS project was organized around a project director, four implementation teams for the functional components, and a core team responsible for shared data elements, reporting and institutional research requirements. User-led teams consisted of users and computing professionals.

A successful selection/purchase process should result in implementation as closely as possible to the delivered base software. The import of picking a "best" package is lessened if excessive customization is a perceived need. Conversely, one must not ignore the fact that purchased software is not an "off-the-shelf" solution and implementation must be viewed as a system development process. Software design and programming tasks are eliminated, but system development must still provide an "institutionalized" solution which integrates the software and data base with policies, procedures and needs. SLU committed very early to a minimum-customization implementation. This increased the importance of team members thoroughly understanding the product's features and capabilities; it also reduced expectations that the software would be changed to fit individual nuances or old practices.

As the project implementation began, two basic categories of tasks began to surface: software-related and data-related. Initial issues and questions were software focused due to the team members early exposure to software selection and vendor software orientation. Although each team was involved in documenting current practice and policy, the software bias threatened user participation by tending to concentrate on technical rather than functional requirements. The data-related tasks began as data conversion planning, but quickly developed into procedural, training, forms and reporting objectives. Figure 1 summarizes major project tasks cast against a project window representing time and effort. This task versus time grid becomes three dimensional when integrated with institutional requirements in the form or management, operational and information needs; existing and changed policies and procedures; and implementation constraints (schedule, personnel, budget).

MAJOR SIMS PROJECT IMPLEMENTATION TASKS
RELATIONSHIP of EFFORT vs TIME LINE

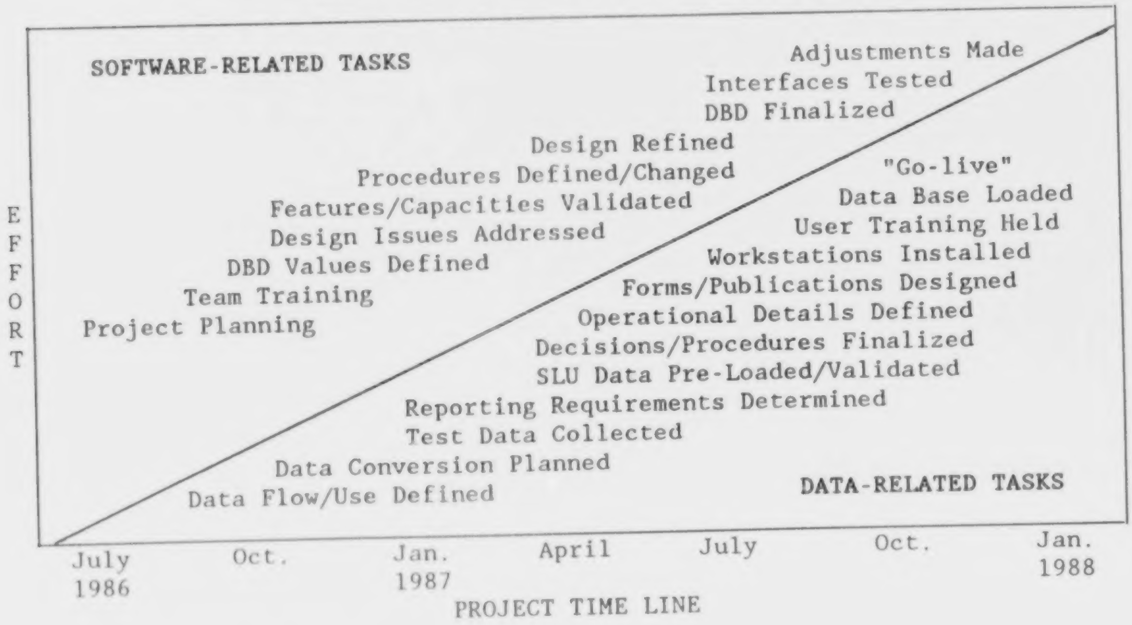
SOFTWARE-RELATED TASKS
Adjustments Made
Interfaces Tested
DBD Finalized
Design Refined
Procedures Defined/Changed
Features/Capacities Validated
Design Issues Addressed
DBD Values Defined
Team Training
Project Planning
"Go-live"
Data Base Loaded
User Training Held
Workstations Installed
Forms/Publications Designed
Operational Details Defined
Decisions/Procedures Finalized
SLU Data Pre-Loaded/Validated
Reporting Requirements Determined
Test Data Collected
Data Conversion Planned
Data Flow/Use Defined
DATA-RELATED TASKS
EFFORT
July 1986
Oct.
Jan. 1987
April
July
Oct.
Jan. 1988
PROJECT TIME LINE

Figure 1

Four major project management challenges were envisioned during the planning stages or developed early in the implementation process:

1. How to foster a thorough understanding of the software's functional features, internalized within the context of desired outcomes.

2. How to transform the participant's orientation from a technical and software focus to a user/procedural emphasis; or how to move from the software-related tasks (which would diminish with time) to data-related tasks which would comprise the most substantial future workload.

3. How to guide the five concentrated, parallel team development efforts toward convergence into a single, integrated, and efficient solution; and how to provide a means to identify and address policy and procedure assumptions, cultural conflicts and differences of views.

4. How to test design decisions, software solutions and procedural changes thus increasing the project success ratio (reducing risk of failure).

The first two challenges generally do not exist in a traditional system development, but significantly compound the complications inherent in the last two concerns. The University addressed all four project management issues by utilizing two specific system development strategies: prototyping and simulations. These tools are not new, but their systematic application within a purchased system implementation may have been. Nevertheless, these tools provided valuable design and decision evaluation forces for alleviating obstacles and accomplishing project goals.

PROTOTYPING:

The use of prototyping as a system development tool has grown considerably in the last few years. While usually associated with traditional system development efforts, prototyping also has application within a purchased software implementation. Prototyping has been defined as the creation of a "working model of automated information processes which begins as a trivial representation, and evolves into a full-scale functional information system" (Little and Lowry, 1985). Other definitions emphasis benefits such as greater user involvement in the development process thus fostering ownership of the application project. Lately, discussions have focused on the numerous prototyping tools, such as 4GL's, CASE (Computer-Aided Software Engineering), code generators and screen builders. However, recent studies at the State University of New York at Buffalo suggest the usefulness of prototyping is diminished if the development process itself is not well understood or is overshadowed by the software tools themselves. It was noted that "Systems developers are so enthralled by today's graphic, narrative, and representational modeling aids that they are losing sight of their mission and forgetting that the map is *not* the territory." (DATAMATION,1987).

Saint Louis University utilized prototyping as a development tool in its SIMS project to integrate the purchased software and associated training with system analysis requirements and to develop a final product focus. This formal 3-month team effort started shortly after training, not as a training extension, but as a tool to finalize and test decisions. A prototype was created combining the purchased software with a functional SLU data base and operationalized according to institutional policy and procedural decisions. It supported all activities of the specific functional areas (student records, billing, etc.), although not for all colleges, courses, terms, students, etc. Within pre-determined parameters, the prototype was developed to be a fully functioning SLU student information management system.

A copy of the base (training) software was loaded with SLU data base values for a defined subset of SLU courses, colleges, students and financial conditions. The prototype effort paralleled actual semester activities and used SIMS processes to test term schedules, sessions and calendars; course schedules; multiple sectioning; department/subject redundancy; admissions; registration procedures; student schedule printing; tuition calculation; residence/board charges; financial aid awards and disbursement; registration cancellations, drop/adds and withdrawals; refunding; GPA initialization and calculation; grading and changing grades; transcripting; standard and ad hoc reporting; plus other system (FRS, HRS) interfaces.

A common orientation early in a software implementation effort is that a system must work under all conditions and all cases, or it does not work at all. This misplaced perfectionism, or paralysis by analysis mode, is a major obstacle to development progress, i.e. all step 1 tasks and problems must be completely solved before step 2 issues are addressed. Prototyping overcame this problem and affirmed the 90-10 rule -- if the initial design worked for 90% of the cases, then future time could be focused on the remaining 10%. There were three other important outcomes: decisions were forced, procedural assumptions disappeared, and teams were sensitized to the importance of interteam coordination and communication. Prototyping verified which designs and decisions worked, but most importantly, made known what wasn't known.

SIMULATIONS:

The formative evaluation of systems and procedures using a robust simulation was another key factor in the SIMS implementation. A simulated registration using students and office personnel was held to test final design, decisions, processes, procedures and documents/forms. The results of these tests were used to further refine the systems for the "go-live" stage.

Planning the simulation required the development of four distinct yet interrelated components. The first component involved goal specification, i.e., stating specifically what was to be accomplished through the simulation. The process by which test goals were articulated called for each team to submit a list of the SIMS data base elements and transactions to be tested. This step was followed by a series of team leader meetings where the test agenda was synthesized. Four goal sets resulted:

1. Test the software in a variety of applications, e.g., cross-listed and co-requisite course requests, tuition calculation under various combinations of college rates, fees, etc.; posting of payments against tuition charges, fees and outstanding balances.

2. Test basic processes and procedures, e.g., course conflict resolution; timing of registration episodes including completion of a registration form, registration confirmation, billing, receipting, financial arrangement processing; payments made by cash, check or third party sponsors; and authorization signatures.

3. Evaluate basic documentation and forms, e.g., schedule of classes, registration form, instructional materials for advisors and students. Assess user understanding, satisfaction, ease of use and common errors.

4. Test administrative support processes and procedures, e.g., the quality of staff instructions and training; type and frequency of data entry errors; staff response to questions from users; tuition charges reconciled to income accounts; and among others, hardware performance (computer response time, terminals, printers).

The second planning component involved development of a linkage between these test goals and the mock registration. The primary linkage was through the creation of 100 student biographies. Each biography reflected a combination of the following characteristics:

1.	Student Type	Undergraduate, graduate or professional
2.	College	Academic unit wherein the student was enrolled
3.	Classification	Year in school e.g., freshman, first year law, etc.
4.	Major	Key to selecting courses, including "required"
5.	Special Tuition	Rates applicable to distinctive programs
6.	Credit Hours	Total number of credit hours requested
7.	Time Status	Full or part-time student status based on load
8.	Dormitory	Residence and meal plan variations
9.	Open Balance	Amount of open balance prior to registration
10.	Payment Plan	Pay full amount due or use budget payment plan
11.	Payment	Amount and method, e.g., cash, check, third party
12.	Financial Aid	Whether or not the student received financial aid

A biographical sketch was given to each participant as a student role to play in the simulation. The proportion of biographies with similar characteristics, e.g., full-time Arts and Sciences students receiving financial aid, approximated actual registrations in recent semesters (Kalsbeek, 1987).

The third planning component involved "seeding" the simulation to test the software and staff behavior. Some student biographies included instructions to register for certain courses thus creating combinations that should have been unacceptable, e.g., an undergraduate student requesting a course from a professional program. Responses to system messages by registration staff and students were monitored. Course offerings were also seeded. Errors in the Schedule of Classes were used to assess how the software and personnel responded to various system messages that appeared at the workstation terminals. Courses were set with enrollment limits to test the usefulness of standard reports, e.g., closed section and demand data.

While testing the software was a high priority, assessment of the actual flow of registrations was critical. Given the limited number (100) of registrations available, two sets of registrations were prepared in the event a "load leveling" intervention would be needed. This contingency plan would provide students with a filled-out registration form to be taken directly to a registration station to assure a relatively even flow of registrations; the simulated registration ran so successfully, this plan was not necessary.

The fourth component involved site selection, registration artifact creation and participant recruitment. A balance was struck between the need to simulate the physical environment of past registrations, e.g., ballroom style registration and the need to manage the evaluation component of the simulation. As a result, a miniaturization of the ballroom format was achieved with the number of workstations at each function proportionate to the past number of registrations serviced during a typical General Registration period. Personnel from the functional offices were trained and staffed the various stations. Registration artifacts included the use of "play" money, temporary student ID's and simulated checking accounts.

Participant recruitment attempted to achieve two goals. Not only were articulate students from a variety of backgrounds sought to participate and provide feedback, but also an attempt was made to create "interest" in SIMS among student leadership. Because of the latter goal, the main source of recruits was a student leadership organization. It was anticipated that such students might become trained aids for the actual registration. For various reasons, the number of student leaders recruited was below test needs. Additional recruits were obtained from summer school attendees and student employees. In July, 30 student volunteers attended an orientation session and were given instructions as to their roles and "identities". Three hours later, 100 registrations had been processed. The volunteers were compensated with gift certificates and dinner after the evaluative debriefing session.

Evaluation Plan

Evaluation of the simulation was organized around four components. The first component called for the measurement of the amount of time needed to complete a registration. A model of anticipated processing times had been prepared, but required validation. Timers unobtrusively recorded the amount of time required for a student to complete a particular episode, e.g., obtain a confirmed student schedule, obtain a printed bill and make a payment to a cashier.

The second component of the evaluation plan called for the application of a focus group technique to obtain registrants' expressions of their experiences. Long used as a qualitative marketing research tool (Calder, 1977), this technique was used as an exploratory approach to student perceptions of the registration. It was intended to generate a kind of prescientific knowledge of the registration episodes. This knowledge was compared with the quantitative data yielded from registration timing.

Each focus group was composed of seven registration participants and a moderator who had been trained and provided with a discussion guide. Each group session lasted approximately one hour and fifteen minutes and was audio recorded. A transcription of each session was prepared for the project team leaders and moderators completed thumbnail sketchs of their groups.

The third component of the plan included development of various reports from user groups. For example, reports were prepared on tests run after the mock registration, e.g., comparing cash register check-out against opening totals, amount and number of financial aid disbursements, and the like.

The final component of the plan included student responses to questions about each registration they had experienced. As each student completed a registration, they returned to the staging area to obtain their next biography. At this time they were provided a feedback sheet to record their initial impressions of what had occurred during their registration episode.

The Results

Timing results for registration episodes were relatively straightforward and described such characteristics as (1) average time spent at a registration station during the initial interaction (it was possible for some students to appear at a registration station more than once to complete a registration); (2) average duration of subsequent registration interactions; (3) average time of combined interactions; (4) average time spent in student accounts; and (5) average time spent at the cashier's station. Additional analyses were planned, e.g., average time of episode by type of registrant, but minimal variation in the length of each episode stayed further analyses.

Transcriptions from each focus group session and student comments on feedback sheets provided two more sources of data. The transcripts provided a rich source of feedback information about participant perceptions of the processes and procedures. A typical student response was:

> "The only problem was that you don't have a copy of your original (registration form) to compare it with what you get out of the computer and I was just wondering if when you're registering, are you going to be able to tell when they're typing it in if it's the same class or not....[T]he alternate section (of the registration form) was very helpful because there was one time where a class was cancelled and there were no other sections offered so they went to the alternate courses and it helped."

The fourth source of data was derived from analyses of work samples or post-simulation testing by each team. For example, students who were scheduled to receive financial aid were compared with the actual registrations. Some teams had planned to test the capacity of the system to generate standard reports, e.g., class lists; but limited resources and time pressures made such evaluations little more than ritualistic.

Translating Results Into Decisions

The mock registration began as an attempt to validate the design assumptions underlying SIMS. The implicit process by which these validations were to occur was a form of classic rational deliberation. Under these conditions, team leaders were to measure system performance against the basic design. The evaluation was to assess fidelity to design. In a sense, the effort might well be described as a ceremony of celebrating the faithfulness of field operations to the design. This activity, or rite, is intended to maintain the existing organizational culture (Trice and Beyer, 1985).

While changes in process, procedure and form that occurred after the simulation can be described, a more important lesson is the process by which these changes were decided. For example, the decision to have a single ply registration form to be retained by the student and similar form decisions, really did not occur in any formal way. Rather sense impressions gathered through the experiences of the simulation, coupled with the transcriptions of the focus group sessions were transformed into the everyday language of the team leaders. Thus, as the project moved toward the final stage, changes appeared as happenings more so than as the result of formal deliberations.

The degree to which the mock registration "fit" the design could have been the consuming agenda in the days immediately after the simulation. Were the teams to have applied a traditional deductive model, precious time would have been lost, frustration increased, and morale depleted. What occurred was that decision refinements simply happened.

Subsequent SIMS team leader meetings and formal and informal gatherings are perhaps better described by "how rules, rather than guiding this process, emerge from it" (Garfinkel, 1967 in Brown, 1978 p. 369). That is, decisions began to happen and were followed by their rationale. In a sense, results were not "translated" into action; results were the actions! The heightened intensity of the SIMS project that resulted from the simulation appeared to transform the teams into what has been described as a "high performing system." In such systems, "...people actually agree, without going through the tortuous processes of negotiation and conflict management" (Vaill, 1981, p. 35).

The mock registration process unshackled the immobility or malaise so frequently experienced following the intense design stage of project implementation (Haugen, 1985). Teams lost their fear of failure and gained a vision of success. Interestingly enough, the design was so complete and the results so successful that project management decided to expand the planned number of registration sites and workstations. This success was realized because the simulated processes were viewed as a final test of decisions and developed solutions. Just as the prototype initiated a reality of an institutionalized system, the mock registration confirmed its completeness.

SUMMARY:

The use of prototyping and simulations as decision verification tools has been shown to have both intended and unintended consequences for project management. The prototype strengthened project teams' understanding of software capabilities, allowed members to internalize the linkages between processes and software elements, and transferred the focus from a technical to user orientation. The simulations validated policies and procedures from both service provider and client group perspectives. The use of these decision tools had the unintended consequences of strengthening morale, heightening confidence levels, energizing user training, and providing the momentum to move the project into the final phases of implementation.

REFERENCES

Bachich, Frank and Hester, P. Lawrence. "Institutional Change - A Fast Track Approach." CAUSE85 Proceedings, December 1985, pp. 187-197.

Brown, Richard Harvey. "Bureaucracy as Praxis: Toward a Political Phenomenology of Formal Organizations." Administrative Science Quarterly, Volume 23, September 1978, pp. 365-381.

Calder, Bobby J. "Focus Groups and the Nature of Qualitative Marketing Research." Journal of Marketing Research, Volume XIV, August 1977, pp. 353-364.

Canada, H. and Heard, E. "Toward the Procurement of an Administrative Software System: A Selection and Group Process." CUMREC85 Proceedings, April 1985, pp. 313-317.

Garfinkel, Harold. Studies in Ethnomethodology. Englewood Cliffs, N.J.: Prentice-Hall, 1967.

Haugen, Elliott. "Implementation of Purchased Administrative Software and Its Impact on the Computing Organization." CAUSE85 Proceedings, December 1985, pp. 457-467.

Kalsbeek, David H. Unpublished management reports, St.Louis University, 1987.

Little, Robert and Lowry, Christina. "The Perils of Prototyping." CAUSE/EFFECT, July 1985, pp. 4-7.

Trice, H. and Beyer, J. "Using Six Organizational Rites to Change Culture." in R.H. Kilmann, J.J. Saxton, R. Serpa, and Associates (eds.), Gaining Control of the Corporate Culture. San Francisco: Josey-Bass, 1985.

Vaill, Peter B. "The Purposing of High Performing Systems." A paper presented at the Conference on Administrative Leadership: New Perspectives on Theory and Practice. Urbana, Illinois: University of Illinois, July 1981.

Whieldon, David. "Prototyping: Shortcut to Applications." Computer Decisions, June 1984, pp. 138-147.

"Why Software Prototyping Works." DATAMATION, August 1987, pp. 97-103.

ADMINISTRATIVE AND STRATEGIC COMPUTING

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ABSTRACT

Information is one of the basic resources available to the manager, just as valuable as human, material or financial resources. The ability to provide information depends on the files and data that is captured and stored. This paper will discuss the files needed to manage a large university and the tasks required to extract the data into information. To obtain this goal, there must be a strategic plan.

Management Information Systems is no more important than strategic computing. The evolution of the MIS concept from an initial focus on data through expert systems, decision, support systems, artificial intelligence and the ingredients for strategic computing will be discussed.

INTRODUCTION

Information is the most important asset we can have when it is necessary to make management decisions that involve the expenditure of large sums of monies for the labor and materials required to produce a product. In other words, what we know about the business cycle of our business can only help us in making good decisions. Maintaining our business data and producing information is what Management Information Systems is all about. We can't have this information unless we plan for it. Understanding what data we should capture into what files and how they are interrelated is important. Why? Because it is the capturing of this data over time, the history of our business transactions that allows us to obtain the information we need to forecast our future business. If we don't capture it, then we don't have the data that is necessary for providing us this wealth of information.

Since our product is the education of students, we will concentrate on the needs for providing information at the operational and management level of a two or four year institution.

DEVELOPING SYSTEMS 1970 THROUGH 1980

The building of a total management information system at the University of Akron started in 1965. The tools were simple with cards and magnetic tape the only available media and the language was COBOL. By 1974, we were looking at on line systems and the strategy was based on completing the systems required for selling our product first. That is, we had a plan to complete the student records area, payroll/personnel second and financial last. We did not at that time have a complete plan. Today we have a formal plan built on the structure of the organization. The systems we implement are managed through a total Project Management System that relies on good standards and procedures. That is to say that our systems are developed using the standard life cycle and estimates are made for each task within a development phase. At the end of each week, time is accrued and reported on each system under development.

The Job Accounting System is designed around the computer standards for system development and operational use. That is to say, our system naming standards that tie the system and all of its parts together are used with the Job Accounting System even to the point that the disk file names are tied to the Job Accounting charge number. At such time as the charge account number expires, the disk data set will be purged and backed up to tape. Yes, the files can be restored.

WHAT FILES ARE NEEDED TO COMPLETE A MIS FOR COLLEGES AND UNIVERSITIES

If we want to build a total Management Information System, then we must look at the organization and analyze what files (data) must be present to do the systems required or the information that is needed to run the University at the operational and management levels.
A typical breakdown of the files required to support Student Records is as follows:

- a. Student Master File
- b. Student Course File
- c. Master Course File
- d. Section Master File
- e. Grades/Transcripts
- f. Graduation Sub File
- g. Student Contract
- h. Prerequisite
- i. Student Account

The Admissions Office will require a Prospective Student File and access to the Student Master File to support their office. Alumni/Development need two files: a) Alumni Master and; b) Gifts/Pledges. To handle the space requirements for Planning, we need a Space Master File and Property Records. The Physical Plant will need a Requisition or Work Order Master File, a Time and Activity Master and an Inventory Master File. This subsystem must be integrated into the General Ledger for charge back.

The Computer Center requires a Work Order or Requisition Master File, a Time and Activity Master File, an Inventory Master File and a Project Management Master. The Library requires four files to make it a complete Management Information System, namely the Book Catalog, the Patron Master, the Circulation Master and the Book Acquisition. Financial Aids must have a Student Application and an Awards File, plus access to the Student Master File if they are to have a complete system. Human Resources requires five files: a Personnel Master, Payroll, Benefits, Faculty Activity and the Budget Position File. The Budget Position Master must interface with the Personnel, Payroll and Budget Master File.

In the Financial areas we need a Purchasing, Payables, Receivables, General Ledger and Budget Master with access to student files for a complete, integrated system. Naturally there are more possible files depending on whether you have a medical school or auxiliary enterprises. I did not illustrate the files needed for the Book Store, Food Service or other auxiliary enterprises.

HOW TO INTEGRATE THESE FILES BY SYSTEMS

It is easily shown that in the Student Records area we can register students with only the Student Master, Student Course, Master Course and Section Master Files. However, we can't check for prerequisites without the Prerequisite Master nor can we counsel students without a degree audit using a Contract Master, etc. What makes the complete, total Management Information System is the ability to add these subsystems that support registration (prerequisites) and advising (degree audit). Let's suppose we wanted to perform a degree audit; a contract file would be built at the time the student entered the college of his or her choice. At grade time, each course attempts in the contract file would be flagged as completed and a list of courses remaining could be printed. At degree time, the contract should be completed with no courses remaining in this file for the student to complete.

The graduation sub-file would be the file of all those students who have applied for graduation and this file will be used to pull the courses from the grade file and compared to the contract file the term before graduation. The graduate sub-file also can be used to determine the line of march and this file can be passed to the Alumni system for Alumni processing after graduation, etc. I could go on and on showing us how to integrate these files into a total Management Information System.

WHAT'S HAPPENING TODAY

Today we see a demand for information and one that must be satisfied within a short span of time. Users cannot wait for two or three days to obtain an answer to their question. If you have your systems developed using a data base language with a retrieved package, you are probably able to meet this demand. If not, you need a fourth generation language like FOCUS or IMAGINE to bridge the files and allow you the ability to retrieve the data and not have to worry about file structure.

In effect, the building of a Management Information System requires the System Analyst to understand the organization, files and systems required to manage a large institution. To accomplish this, a good five year plan should be instituted.

The University of Akron formulated such a plan in early 1986. The strategy was to have a five year plan completed by April, 1986. In January, the President designated the Director of Computer Services as the Chairman of the Computer Planning and Policy Committee, whose body consisted of the Provost, Vice President for Business and Finance, one Dean, three faculty members and two administrators. The committee was in agreement that computing was too broad to look at as one whole entity. We divided the spectrum into six areas: 1) large academic mainframe computers; 2) mini and micro academic computing; 3) Computer Based Education; 4) Graphics; 5) Administrative Computing; 6) Networking; and 7) Office Automation. Several subcommittees were formed by selecting faculty and administrators most knowledgeable from their respective areas. The subcommittees interviewed faculty and administrators across campus, completing their reports by March of 1986. In April, the plan was developed with estimated costs for each area. The total plan was estimated at $12 million and today we have spent about $6.5 million. We have implemented the large academic mainframe recommendations and are presently working on the Office Automation, Networking and Administrative portions of the five-year plan. However, any plan requires monitoring and can expect change. We are now in our second year of the plan and working on updating the plan.

This leads us to a second area of concern: What about strategic computing?

STRATEGIC COMPUTING

IMPORTANCE OF INFORMATION MANAGEMENT

Information is one of the basic resources available to managers, just as valuable as human, material, or financial resources. It is hard to imagine the manager of today functioning without the use of sophisticated information management tools.

INCREASING COMPLEXITY OF THE MANAGEMENT TASK

Management has always been a difficult task, but it is more today than ever before. The sheer size and complexity of the organization requires the use of information management systems. The current trend toward factory automation and robotics demands an ever increasing dependence on information systems.

The fast paced nature of today's business environment requires management to respond quickly to competitive pressures. Computer based management systems are the mechanism that allows managers to respond in a timely fashion.

All of these factors--size, complexity, technology, and competitive pressures--influence the management task. Information systems have become central to the functioning of management in most organizations. The planning and implementation of such systems, can give the organization a competitive edge. Strategic, long range, planning of computer based systems is a crucial role for top administration.

AVAILABILITY OF DECISION-MAKING TOOLS

Even as the manager's task has become more complex, there has been a movement under way to improve the effectiveness of decision making. Central to this movement are quantitative techniques and computers. Terms such as management information systems (MIS) and decision support systems (DSS) represent currently popular means of assisting the manager with computer-produced information. MIS refers to the overall application of the computer in a firm, with the emphasis on supporting management's information needs. DSS refers to efforts applied in a more focused way--on a particular problem faced by a particular manager.

MANAGEMENT SKILLS

A successful manager needs to possess both decision-making and communications skills. Managers on all levels must decide on strategies, tactics, and operations. They also must communicate with persons reporting within and without the organization.

Today most middle managers have received some formal computer training. They are becoming more knowledgeable in computer basics and able to communicate with the computer professional. These managers and computer specialists can jointly develop computer-based systems to solve business problems. The new manager has an understanding of the strengths and weaknesses of the computer when applied to business problems and are able to use the computer as a decision support system.

EVOLUTION OF MIS CONCEPT

It was not until the mid-fifties that computers were marketed on a widespread basis. Computers were used on a limited scale for processing accounting data rather than producing management information.

During the early sixties, information retrieval was developed. It was primarily concerned with storing, retrieving, and displaying information. Many of the systems of this era failed because management was overly ambitious. Firms erroneously believed that they could build a giant information system to support all levels of management.

The current focus is on decision support systems (DSS) and communications. The DSS provides support by actively involving the managers and providing analytical software to manipulate a data base. The MIS plays a more passive role by providing information that managers must interpret and apply at the operational level.

Since around 1980, interest has been aimed at office automation (OA). These systems seek to provide productivity gains through electronic communications. Office automation provides word processing, electronic mail, teleconferencing, voice mail, electronic calendaring, document transmission, and other means of increasing office productivity.

The current focus is on the linking of articial (AI) intelligence and expert systems to the MIS. AI seeks to provide logical human reasoning by computer. Expert systems are a subset of artificial intelligence. Expert systems will eventually provide the primary link with DSS. Instead of DSS simply assisting the manager, the expert system will be able to suggest alternate ways to make a decision.

ACHIEVING THE MIS

The manager is ultimately responsible for the MIS. The planning and control of information systems requires the involvement of top level management. New fourth generation software is easier for managers and end-users to use. This user friendly software has stimulated many users to do their own computing using on-line workstations. The microcomputer boom has also fueled this intense desire for end-user computing.

INFORMATION NEEDS OF EXECUTIVES

Executives are different. An executive is not just a lower-level manager working on a higher level. The job changes drastically when the manager reaches the top. Top-level managers receive most of their information from subsystems. It is necessary to process lower-level data into useable information for top management. Any executive information system must take into account the special needs of top-level management for summary data as well as forecasting trends.

STRATEGIC COMPUTING

The increased computer literacy of users and the ease with which users can acquire their own computing facilities have made many firms realize the need for a new corporate attitude toward computing. It is necessary for top management to devise long-range plans specifying information requirements and identifying the application of existing technology. Strategic computing requires the following ingredients:

1. The chief information officer (CIO) should report directly to the president.
2. A data administrator should establish and enforce policies and procedures on company data.
3. Information services department should have a documented understanding of data flow throughout the organization.
4. Long-range planning should identify information resource requirements.
5. CIO should establish organizational wide MIS policies.

CONCLUSION

The combination of a good CIO that can manage data, set long range plans that include both the operational and top-level management, provide the capability to retrieve information using fourth generation level languages, three distribute networks and decision support systems is the basis for strategic computing.

STANFORD JUMPS TO THE '90'S

DISTRIBUTED PROGRAMMING

PROMISING OR PREMATURE?

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The paper outlines the growth and success of Stanford's centralized administrative systems programming organization, Information Services, over the past five years and the unique turn of events which have led to its decentralization into client offices during the latter half of 1987. Key reasons for the growth of the organization including joint reporting relationships with clients, a focus on building service and quality from the grass roots level, use of modern programming techniques, and an early and strong commitment to meeting the needs of campus departmental units are discussed. Of special interest is the way in which all of these attributes led to a predicable decentralization in the early 1990's which was accelerated during 1987 because of unforeseen factors. The challenge ahead for Stanford is to manage the problems created by this relatively sudden change in such a way as to "get a jump" on how to keep information systems functions in tune with client and technological requirements for the next decade--the "promise" of the distributed programming model.

I. INTRODUCTION AND OUTLINE

What I present here is a review and analysis of recent events at Stanford University in the information systems arena. It is a study that I believe I have a professional obligation to present to this group of interested peers, but, I must admit, I would rather be listening to one of you tell about how it happened somewhere else! Let me begin, then with "Stanford Jumps to the 90's—Distributed Programming, Promising or Premature?"—or, as an alternate title: New mail on node VAXF from CUBLDR::PATTEE_D "Donna" "Stanford's Second Major Earthquake!"

During the course of this paper I will cover the following major areas:

--The Information Services Environment at Stanford in the 80's

--Key Milestones in I. S. Evolution Since 1980

--Changes in the Air--Early 1987

--Decisions Made and Directions Set

--Implementing the Decentralization Plan

--Prognosis for the Future

II. THE INFORMATION SERVICES ENVIRONMENT AT STANFORD IN THE 80'S

It was clear by the late 70's that Stanford needed to overhaul its core administrative applications both to better meet client needs and to take advantage of new information technology. Thus, by 1980 the university had decided to proceed with major new development in the financial, student, and alumni and development areas. A search was also launched for a Director of Administrative Information Systems with a administrative user background rather than with a technical one.

The demand for more (and more articulate) "user involvement" was very strong. The existing Administrative Data Processing Services unit had an only partially-deserved reputation for taking too long to deliver applications and costing too much. The sense was that by the time ADPS delivered a product the client's needs had changed and he couldn't afford to pay for it. Users demanded to be more a part of the development process.

Greater flexibility in the systems design process with better modification capability was essential. The concept of "iterative development" was emerging and being adopted at Stanford. This, coupled with the selection of a fourth generation data base management system with which to do all of the new applications development addressed both the flexibility and modification capability issues.

Another factor in the information services environment was the change in both the number and nature of IS clients. The traditional central administrative office clients like the Controller's and Registrar's offices were playing very active roles in the design and development process of their new applications. There was strong emphasis on the value of information and how it affected the quality, service, and productivity of the central offices. In addition, a new set of clients was surfacing as the departmental unit, both academic and administrative, came to be recognized as the real initiator and ultimate user of administrative data. At the same time the individual, particularly one with a terminal or PC, was seen as yet a third type of client, distinct from both the central office and the department.

By the latter half of the 1980's the departments had become an extremely strong factor in influencing the priorities of central administrative offices and of IS. They soon realized that the millions of dollars spent on "central systems" development in the previous five years hadn't given them all that they needed at the "departmental" applications level. The departments were ready for "their fair share" and weren't at all sure they would get it if it were to come out of the central computing organization.

III. KEY MILESTONES IN I.S. EVOLUTION SINCE 1980

In January of 1980 the Center for Information Technology (CIT) was formed to provide a single campus focus for all computing and information technology activities. Its formation indicated a strong commitment by university management to promote these functions via a single, central organization.

Early in 1982 the Administrative Information Systems (AIS) organization (as IS was called then) which was a part of CIT reorganized to reflect Stanford's own admistrative structure. Thus, AIS had units responsible for the Controller's Office, student systems, the Alumni and Development Office, the Hospital, etc.

In addition, the unpopular hourly programming rate was abolished and replaced with detailed annual budgets for each client area with clients paying for AIS services on a monthly basis according to the agreed-to budget. Another successful organizational strategy was the concept of joint reporting relationships where AIS Assistant Directors reported jointly to the AIS Director and to the head of their client area. For example, the Assistant Director for Financial Systems reported both to the Controller and to the Director of AIS. Borrowing from the legal concept of joint tenancy, each supervisor "owned" all of the Assistant Director. The Assistant Director would, in turn, supervise programming staff in the Controller's Office and in AIS. Since both staffs had the same "boss," much of the "we/they" attitude went away.

Later in 1982 the Stanford-developed SPIRES data base management system was chosen as the principle DBMS for development of the new central administrative applications. This decision came after months of study of the alternatives and a firm conviction that a single DBMS in a "fourth generation language" would provide the best system integration, speed the development process, and involve the users to the greatest degree possible. At the time SPIRES and FOCUS were ranked similarly in the Stanford study, but in the end SPIRES was chosen because the staff supporting it were already in place on the campus and the future direction of SPIRES could be determined locally.

At the end of 1982, it was evident that some guiding principles were needed to integrate the several major development efforts that were going on simultaneously and to focus the campus on the ways in which administration at all levels could and should change once the new applications were in place. The "Administrative Systems Architecture" became the guiding concept around which the development effort took place. The Architecture was simple, easily understood, and in some ways, very subtle. At its center was the departmental unit surrounded by the central administrative offices with the whole connected by campus electronic networks. The basic tenent was that the department, both as originator and ultimate user of most administrative data, was the most important client of all. The department and its growing local computing capability had to be recognized as having perhaps the most critical stake in the so-called "central systems development." This fact, coupled with the growing realization that central administrative offices exist primarily to serve departments and not vice versa, influenced the way in which the new development was done and continues to influence today's information technology at Stanford. Although in some ways simplistic, the Architecture served to focus both technologist and line officer alike on the fact that the new development and the efforts that came after it had much less to do with computing than it did with the way in which people do their day-to-day administrative work.

1983 marked the beginning of the shift away from a single, large information technology organization to manage all of Stanford's efforts in this arena. In a move to bring "academic computing" closer to academic administration, academic computing consultation and academic networking support were shifted from the CIT organization and placed under an Associate Provost. CIT became ITS, or Information Technology Services, and inherited both Telecommunications and Graphics and Printing Services. While the Director of CIT reported to the Provost and two Vice Presidents, the Director of the new ITS (the same person, by the way) reported to the Vice President for Business and Finance and ITS became a part of the Business and Finance organization.

As personal computers proliferated on campus and the needs of departments became more evident, a group of professionals was organized in IS to provide support to departments at least commensurate with that being supplied to central administrative offices. This unit of IS was called Departmental Information Services (DIS) and was formed in 1984. DIS did extensive surveys of campus departments including several in depth studies of specific departments to assess and rank departmental needs and establish DIS staffing priorities accordingly. Over time DIS became expert in providing consultation and support to departments and individuals in the information technology arena. The group became the leading advocate for departmental and school information services support and continued until its elimination in 1987 to operate with a large backlog of consultation requests.

As the new applications development proceeded the need for a common user interface came to the surface. While one set of commands used to access student data all day by an employee in the Registrar's Office was workable, a staff member in the Biology Department needed access to student, financial, purchasing, and alumni data all in a day's work. On-line access commands in each of these applications could differ widely even though they were all written using SPIRES. Thus, for most departmental employees different sets of commands would have to be learned for each application if they were to use the new systems. To overcome this problem, a single set of menu- driven commands was developed to cut across all major applications to facilitate use primarily at the department level. This interface, called "Prism," was introduced in 1984 and is widely used today at Stanford.

In 1985 development on the new applications was far enough along for the campus to begin testing departmental on-line entry and access to several kinds of data used in departmental administration. The Departmental Access Pilot Project was begun to open up access to several departments at no cost to them to gather data on what would be required to provide entry and access to all campus departments within the next few years. The pilot project resulted in a great deal of important data on costs, training requirements, and technical issues which formed the basis for planning the implementation of full access by the end of the decade. This would mark the ultimate implementation of the Administrative Systems Architecture.

By 1986 concern was growing among the central administrative offices that the new applications were costing more to run than they had anticipated. Most of the energy and attention related to budgeting for the new applications had focused on allocations for the development costs and, while several accurate projections had been made in 1982 on future operating costs, no one had paid much attention to them. As client computing budgets were overrun, fingers were pointed and scapegoats were sought, but the end result was a call for major cost reductions. Since most of the overspent budgets were for ITS computing charges, the principle target for cost cutting became the ITS organization. Ironically, DIS, which was funded almost totally from ITS mainframe revenue, came under heavy attack while providing some of the most popular ITS services to the growing departmental clientele. In the end, the political pressure was too great and DIS was sacrificed in August of 1987. Much of the time of the senior leadership of ITS from early 1986 until the organization was disbanded in mid-1987 was spent in budget reviews and program defense rather than information technology. Just how much was lost of the leadership role Stanford developed in this area in the five previous years during that 18 month period remains to be seen.

IV. CHANGES IN THE AIR--EARLY 1987

Sometime in late 1986 or early 1987 the Stanford Provost reportedly began to examine the idea of pulling all information-related resources together under a new vice presidential organization. In this plan the ITS functions, those split off from CIT in 1983 and placed under an Associate Provost, and the Stanford University Libraries would be combined. The concept of including the libraries was not new, of course, given the experience at Columbia and elsewhere, but it had not been considered seriously at Stanford in the recent past. Rumor had it that the Provost thought the idea made a good deal of sense, but did not want to make the organizational move unless the libraries would go along. Apparently, he also did not believe that a new vice presidency could be justified with only the ITS and Associate Provost areas included. Only a small circle of people knew the idea was being considered until early February when it became more widely known and some opposition began building in the libraries.

The Provost had also begun a gradual shift of reliance and emphasis from the Business and Finance organization. More and more staff work that had traditionally been done in Business and Finance or shared between that organization and the Provost's Office was now handled by the provostial areas. Long-time Stanford watchers noted the change to more symbolic and real management of the institution by the faculty and academic administrators.

By 1987 ITS was under heavy pressure to reduce its budget even after having made multi-million dollar reductions in 1985 and 1986. Lay offs were being considered and morale was at an all time low. More importantly, as far as the future of the organization was concerned, ITS was becoming a major liability to Business and Finance which had already witnessed its own star dimming. The fact that ITS was ultimately disbanded is as much attributable to its lowered status and reputation as it was to the Provost's desire to pu sue the idea of a new vice presidency. Had ITS been a strong and popular organization within Business and Finance, it probably could have survived particularly given the fact the the libraries effectively kept themselves out of the Provost's plan.

Actually, the "downsizing" theme had been rolling across the campus for some time beginning with the Hospital in 1985. ITS was not alone in its budget cutting and other areas in Business and Finance were affected as well. Early in 1987 the concept of "smaller is better" seemed to be the most popular bandwagon making one wonder if some of the early ideas of the "junior Governor Brown" had acquired a new following.

V. DECISIONS MADE AND DIRECTIONS SET

In mid-March I met with the Vice President for Business and Finance, Bill Massy, and he said that he had just come from a meeting with the Provost and the establishment of a Vice President for Information Resources was a virtual certainty. The libraries would participate only to the extent of a coordinator in the new Vice President's staff, but ITS in its current form would be fully subsumed by the VP-IR organization. The official date would be around July 1.

All of this information was basically known by most of us at this time and the meeting with Dr. Massy merely made it official. What he said next, however, came as a complete surprise. He told me that he believed it was probably time to split up IS as well and distribute the several programming groups to the central offices for which they provided service. His reasons centered around his belief that the new VP-IR did not have administrative computing high on his priority list and if IS were to become a part of IR, it might be neglected. He also stated that the clients probably wanted to get "their" programmers back at this point anyway. Massy said that although he was interested in my thoughts on the issue, he just could not see any good reason for holding the group (IS) together. I think this group of listeners won't be surprised when I say that my views diverged from those of the Vice President!

My initial reaction at this meeting with Dr. Massy was that I knew of no client who wanted to supervise programmers and none were less than satisfied with the service they had been receiving from IS. As to the point that IS might be neglected in the new IR organization, I noted that we were basically self-sufficient anyway and had never relied on strong supervision from above or a collection of other technology-based organizations around us for success, much less survival. For that matter, if there were a concern for IS being a part of IR, why didn't Massy just keep us since we were still at that time a Business and Finance entity? I did agree to take the next two to three weeks to interview all our clients, most of the IS staff, and talk to some of my colleague IS directors at other institutions to see if I simply had lost touch with what was really going on with my own organization.

On April 26 I completed my review and reported back to Dr. Massy in a paper entitled: "The Role, Function, and Organization of Information Services." In a nutshell, I found that all of our clients believed that IS had served them well in the past and was continuing to do so. The weakest support came from a client who said that the plan to decentralize IS probably could work. The IS staff and many ITS staff who worked closely with us, were adamant about the need for the organization to stay as one. Many were curious as to why a functioning, well-run, and basically well-respected organization was being considered for demise. One staff member quipped: "It sounds like someone is saying: 'It's fixed, let's break it!'" My discussions with other IS directors yielded surprise and concern that Stanford to whom many had looked for leadership in the IS arena, seemed to be bowing out of that position.

My primary recommendation to Vice President Massy was that IS stay together as one organization either within Business and Finance or moving into the new IR organization. Some of my reasons for this recommendation were:

--the economies of scale resulting from a single IS organization are significant and can be measured both in dollar and productivity terms

--programmers are more productive and effective as part of a larger professional peer group where ideas can be traded easily, organizational loyalty develops, and several career paths are available

--IS is in the height of its success, liked by its clients, with a devoted and loyal staff, and respected by its peer IS groups

--IS has remained within or below its budget for the past six years and, in fact, turned money back to its clients

--IS clients don't want "their programmers back"

--a better time for decentralization of IS would be in the early 90's when the systems development is completed and departments are fully on line

I concluded my report to Dr. Massy with the following:

> Information Services, in the spring of 1987, finds itself betwixt and between. Its people have worked hard to achieve the ability to facilitate, not hamper the business

> of its clients and to do so while being as "invisible" as possible. It would be an unfortunate irony if IS has been so successfully invisible as to be considered unnecessary as an organization. This is not a view held by IS and, more importantly, it is not held by IS clients.

Vice President Massy committed his own thoughts to writing in a "Talking Paper on Administrative Computing Reorganization" in early May and used that as a basis for his own set of interviews with IS clients, staff, and others. He evaluated the then-current situation and had these findings:

--major administrative applications are nearly complete

--support for departments is critical, but progress has been unsatisfactory because "do-it-yourself" groups have sprung up to try and provide support

--there has been a lack of high-level (meaning vice and sub-vice presidential) attention to the business problem of local and central systems connectivity

--there is a need for comprehensive stratigic thinking, planning, and cost-benefit analysis for administrative systems and their role in productivity enhancement--this is a business, not a technical issue

The basic conclusions reached in the Massy paper were stated as:

* It is no longer necessary for applications programmer/analysts to report to a centralized technical organization in order to achieve acceptable technical outcomes. Decentralization of this function will enhance the focus on business issues and also eliminate much of the overhead of the central organization.

* Administrative system planning and development is part of the fabric of the line operating function. It cannot be effectively delegated to a centralized technical or information organization. (Of course the central organization can facilitate the process, as described below.) Line operations lacking in local understanding of administrative system principles and capabilities should develop appropriate internal resources as soon as possible, or else make arrangements for organizations with similar work processes to assist them.

* Strategic planning and oversight for administrative systems should be university business functions. Concentration should be on what work is needed and how it is to be performed, rather than on the more abstract concept of "information." This function should include determination of the scope and focus

of our various administrative systems, the boundaries between them, verification of the "ownership" of each system and the responsibilities of the owner, and the adjudication of data access issues where necessary.

- * Not-with-standing the above, administrative systems planning, development, and refinement must continue to be closely linked to and well supported by technical and information resources. University-wide peergrouping of applications programmer/analyst personnel must be nurtured and utilized effectively; this function is best done by the new Information Resources organization.

A new organizational structure was proposed in the "talking paper" and discussed with clients and staff of IS. The key points of the new structure were:

--IS would be disbanded and the programmer units distributed to the line organizations

--the Software Acceptance and Quality Assurance unit would move to the Data Center in IR

--the administrative systems strategic planning function would move to the Vice President's office in Business and Finance

--a process would be established to facilitate programmer-analyst "peer grouping"

--a "Front Line Departmental Systems Group" would be established to develop, maintain, and enhance departmental administrative systems

--an "Administrative Productivity Council" would be formed to provide policy level leadership

After further discussion with clients, staff, and me Vice President Massy announced publicly on May 19 that he had decided to proceed with the structure he outlined in his talking paper.

I am reminded of a question from the audience during a panel discussion in which I participated at the Snowmass Conference over the past summer. I had been giving an abbreviated version of the contents to this paper to bring people up to date on what was going on at Stanford. A gentleman stood up and asked me how I knew it was time to decentralize IS at Stanford. I told him I knew because the Vice President for Business and Finance told me so--twice! May 19, 1987 was the second time.

VI. IMPLEMENTING THE DECENTRALIZATION PLAN

A transition team to implement the IS decentralization was formed in June and charged by Dr. Massy to complete the process by December 31. Members of the team were the Director of the (new) Stanford Data Center, a staff member in the Business and Finance Management and Financial Planning office, and the Director of IS. We met weekly through August to deal with the transition issues and to keep the lines of communication open both within IS and between IS and other concerned organizations--particularly client organizations.

Several key issues arose during the transition period that are worth noting. First, in the budget area, we had to determine if the funding available to support IS in its centralized mode would be adquate to provide support to the several decentralized units. In addition, the new functions (strategic planning, "front line systems" and the like) outlined in the Massy paper had to be costed. Then, there would be the computing charges from the Stanford Data Center for 1987-88 that had not yet been estimated. All of these costs would have to be summed and compared to the known existing funding including the amounts previously used to fund the IS Director and his office which would "go away" under the new plan.

In the personnel and staffing arena, the principle issue was the determination of which staff would go with which client area. It wasn't as simple as just dividing up people based on the IS division breakdown because many programmers were split between two or more cost centers. Eventually we settled on distribution based first on the foreseeable maintenance and development needs of the several client areas matched against criteria of skill set mix, critical mass, and simple equity. Another issue was the spectre of layoffs as we tried to make sure all programmers and support staff were placed, but had no assurance that some wouldn't "fall between the cracks." Finally, we faced the need to announce all staff changes at the same time so that information about people's futures wasn't trickling out little by little. In the end, we announced a date upon which all IS staff would learn to whom they would report and where they would work.

Space was another issue that required our attention as the Massy paper called for the programmers to be located with the clients for whom they would be working. First we had to determine the requirements based on the programmer distribution plan and then evaluate the space available in the client areas. Needless to say, this issue was placed on the "back burner" until other items were settled. Space on the Stanford campus has the same volatility as it does on other university campuses!

Finally, and most importantly, were the morale issues. The IS staff was extremely agitated with the decision to proceed with decentralization. These concerns were building in intensity daily and it was essential that opportunities be provided for staff to express their concerns on a regular basis. The opportunities were made available for both public and private expression and interchange with a person or persons who knew what was the current situation. We worked hard to keep the information about the decentralization process flowing to the staff in electronic mail messages, through supervisors in staff meetings, and in regular social gatherings. The key was to keep the focus on the future and not let the general desire to hang on to the IS of the past postpone the inevitable. By maintaining a high visibility and availability of the IS Director and his Assistant Directors to the staff, severe productivity losses were avoided. Still, most of the summer of 1987 represented the lowest ebb in the output of the IS staff. Offices in the IS building that normally had lights burning well into the evening and on weekends too, now were dark at 5 and rarely occupied on weekends. Staff morale was probably the single most important issue dealt with during the transition period.

The status of the IS decentralization in December of 1987 is that it is basically complete. The organizational and budgetary changes were accomplished on September 1. The IS staff is still occupying the same building with no new space to move to for at least one year. The Director's Office staff who were not transferred to client areas all have found new jobs. No layoffs were necessary and no one quit. Basically the consolidated IS budget was adequate to fund IS-type functions in the client areas and some new dollars were made available to fund the strategic planning and "front line departmental systems" initiatives. No action has yet been taken on the "Productivity Council." The IS organization will cease to exist, on schedule, on December 31, 1987.

VII. PROGNOSIS FOR THE FUTURE

The events of 1987 are much too recent and, in fact, the results are still unfolding for any accurate post mortem to be done at this time. I believe it is much more important to focus on trends which led up to the IS decentralization than to worry about whether the same thing will happen on your campus. These trends and the way in which they are addressed can have a major impact on the role and the vitality of your IS organization, and, for that matter, of your institution.

First is the strong need to integrate the business functions with the applications supporting them. There is not the "work of the Controller's Office" and the "financial system." They should be one in the same or at least have that as the goal shared by the programming and the functional staffs.

Secondly, is the tendancy of some clients to let the IS staff make the decisions on how best to make the application support the business functions. We found that the point can actually be reached where a client and programming staff are so well integrated that the technical group may be "calling the shots" in some parts of the client business. It is an ironic twist from several years ago when we were all admonished to "learn the client business" and don't "talk techie" all the time. Many would argue that this degree of client/technical staff integration is admirable, but the lesson is not to let it be perceived as the client shirking its responsibility.

Third is the absolute necessity to pay attention to the schools and departments. Inevitably they will emerge as the prime force driving administrative systems and those responsible for them. IS at Stanford started chanting that theme (and doing something about it) in early 1983 and we could have done even more.

Finally, and perhaps most importantly for you IS types, is the need to develop a role for the IS organization beyond that of a simply technical group. The IS of the future will need to focus on the nature of administrative work and how information systems can make a difference in improving productivity and "working smarter" in client areas--especially departments.

There are several questions that will remain unanswered for some time as life in a decentralized environment evolves and evaluation of the results of the management decisions of 1987 begins. Some of these questions worth watching are:

--Will good programmers continue to work in an environment where the peer group has gone from 90 to 9 or less?

--How key was the existence of a strong, central IS organization to systems sharing, standards adherence, client cooperation, and the like?

--Will the "smaller is better" concept truly allow for coordinated, integrated approaches to meeting departmental information needs?

--Will the decentralized approach save dollars across the University or will all the new pieces add up to more than the orginal whole?

In closing, let me briefly state my personal opinion on the situation with IS at Stanford. My speech is titled "Stanford Jumps to the 90's" because much of the decentralization put into place over the past six months we had intended to do in the early 90's anyway. I do think, though, that we "jumped" too fast. My title also asks the question "Distributed Programming, Promising or Premature?" Simply put, I believe that distributed programming at Stanford University as instituted in 1987 is a promising idea prematurely implemented. But, then, that is only the personal opinion of one, soon to be emeritus, Director of Information Services.

As they say, "only time will tell" and the only fair way to end this story at this point is not with "the end," but with: "to be continued....."

THE DIRECTOR DONS THE BANKERS CAP

or

NEED A PC? HAVE I GOT A DEAL FOR YOU!

Arthur Brooks
University of Missouri - Rolla
Rolla, Missouri

With the introduction of the Personal Computer to the business world, images of a magical work producing box danced through the minds of the University departmental directors. At no time had a single piece of business equipment created such a near instant demand. The wondrous new computers dangled before the administrator's eyes like the golden ring on a merry-go-round. However, with budgets which barely met current office obligations, the new devices were well beyond the financial reach of most departments. In 1985 this campus of the University of Missouri instituted a self-funded Personal Computer loan program which allowed the departments to purchase PCs and repay the money over a forty-two month period of time. This paper describes the process created to manage the fund and relates the experiences gained from the program which is nearing the end of its third year of existence.

When the IBM Personal Computer was realized as a potential business tool in the early part of this decade, the University of Missouri - Rolla administrative departments were faced with a serious problem. Everyone seemed to want one of the new magical boxes, but very few people had the funds to finance the purchase. While the prices were attractive, the amount was simply more than any departmental budget could afford. As for fully justifying the purchase, no one really knew how they were going to use the new devices, they just knew they had to have one. To the departments, the new Personal Computers provided a sense of freedom from the dependence they had on University mainframe computers and computer programmers. This new device suddenly became a way to handle all of the office duties. No longer would they have to endure the routine of having their requested report put on a work priority by the computer center director. Then they had to wait while the programmer defined the report, wrote the program and finally produced the results. None of this seemed really necessary to the typical administrative user and it was a process the administrative user wished to eliminate. In the eyes of most directors, one of the new Personal Computers would save the department money, time, be more efficient and the results would impress their superiors. Who needed those computer people anyway?

Consequently, during the first year or two, there was a mad scramble to secure monetary assistance to buy PCs. Scarcely a department had the funds to purchase the desired equipment from their own accounts. They needed to seek the financial support of a higher level administrator. These administrative benefactors found their desks cluttered with proposals for the purchase of Personal Computers for the benefit of campus departments. With insufficient funds to satisfy all requests from campus units, these higher level administrators chose the proposals they determined to be in the best interest of the campus or their own administrative area. From this activity developed two distinct camps, the 'haves' and the 'have nots.' The fortunate group of campus units embarked on a flurry of activity with their newly acquired micro computers. They were too mired in the business of how to work these new tools to worry about the productivity of the machines and the reality of their ambitions. On the side lines, the 'have not' camp sat and watched the flurry of activity with much dismay. If only they had been chosen ....

In May of 1984, the Director of Administrative Data Processing (ADP) at UMR submitted a proposal which entertained the idea of designating a specified amount of campus money for the procurement of Personal Computers for campus administrative units. The concept was not a particularly new idea for other universities, but it was new to the University of Missouri. This plan was targeted to assist those campus departments who were currently renting computer terminals from the Computer Center, campus administrative divisions who had computer equipment rental as part of their existing budget. The desire was to be able to present to the administrative units an opportunity to replace their computer terminals with newer equipment while maintaining a near constant departmental budget. With this in mind, it was initially proposed the funds be made available to campus units on a thirty-six month loan basis. The loans were to be repaid on a yearly basis, with a nominal interest being charged. By this approach a substantial portion of the 'have not' camp would be satisfied and the campus productivity, hopefully, would increased. The following arguments, supporting the self-funded loan concept, were presented to the Chancellor:

1. The number of departments purchasing PCs would increase, thereby addressing the Chancellor's stated desire to significantly boost the campus administrative computing activity.
2. In three years the Chancellor could receive his investment back, with interest. (A change from his funding equipment with no monetary return.)
3. Through time payment budgeting the departments could establish a method to extend their office configurations or upgrade their computer equipment when the current obligations were met.
4. The Chancellor could be assured this collection of departments would not be approaching him in a few years with requests for additional funds for PC replacements.
5. No departmental budget increases would be required to implement this plan.

In January, 1985, the Chancellor of the Rolla campus committed a sum of $70,000 for the use of purchasing Personal Computers for administrative departments. The details of the restrictions associated with the administration of this account was left to the discretion of the Director of Computing Activities - Rolla and the Director of Administrative Data Processing - Rolla. After due consideration it was determined by these two individuals that the users would repay the money on a forty-two month basis. There was a concern expressed regarding the users experiencing hardware difficulties and being faced with having to pay the cost of the repair. Of particular concern was the thought that some borrowers might attempt to return the PC to the campus computing entity rather than bearing the cost of repairing the device. At that point in time, the two individuals responsible for the fund were still not totally convinced the new devices would prove to last beyond the fad stage. Neither individual wished to accept the return of a device which they were not sure they could re-sell. Consequently, a monthly maintenance was included in the repayment schedule. While there was concern this item would increase the monthly repayment rate too much, it would handle the problem of PC repair. It was also stated with the early PC fund borrowers that the PCs were the property of the individual departments and the computing office of the campus would not accept the return of the equipment.

After considerable discussion the Director of Computing Activities and the Director of ADP established the policy that the loan fund borrowers would pay 13% simple interest and 16% for maintenance. Using these figures, a monthly loan payment amount was derived. Not wanting to deal with monthly statements, the Director of ADP, who was designated as the loan fund administrator, established the policy that all repayments would be made only once during the fiscal year. The department's obligation was to start with the first full month after the PC was delivered and the department's obligation was due immediately for the current fiscal year. For each successive year, the PC time purchase repayments would be made at the beginning of the fiscal year. It was contended this procedure was in the best interest of both the fund and the department. If the University were to reduce budgets after the start of the fiscal year, the loan fund would not bear the effects of such cuts and the department would have protected their time payment obligation. This is a procedure which remained in effect for only the first year. Since that time the re-payments have been handled anytime during the fiscal year the department wishes to process the paper work. These payments have more frequently been paid at the end of the fiscal year.

A formal repayment schedule and loan stipulations statement were submitted to the borrowers with the first few purchases. Those stipulations included such statements as:

1. All payments were to be paid at the beginning of the fiscal year.
2. The PCs could not be returned to the Computer Center.
3. The devices were the property of the borrowing department.
4. If the borrower wished to sell the PC, the Administrative Data Processing department would attempt to help the department find a buyer, but ADP would not accept any responsibility for the device.

It was felt such statements were necessary for the computing entity of the campus as the micro computers in the office had not yet become a proven reality. The computing directors believed the computing entity had to afford itself some sort of protection from those departments who launched themselves into an area which they could not maintain. Obviously, there was a note of pessimism regarding the permanence of the PC in the office.

For a department to utilize this fund, the Director of ADP requires the potential borrowers to contact him with their needs for a Personal Computer. After determining the department's desired configuration, the ADP Director informs the department of the cost of the configuration they had jointly identified and the loan stipulations. Upon confirmation of the department's desire to time purchase a Personal Computer, the Director of ADP creates the proper University purchasing documents to purchase the defined configuration. In some instances the Director has been able to submit a single equipment bid for several departments, resulting in the University receiving lower component prices. Upon arrival of the equipment, the Director arranges for the installation of the new equipment by the campus Computer Center. All cost for equipment shipment and installation are borne by the time payment account.

Prior to the establishment of this program, the campus Computing Center had established a Personal Computer repair effort. It is this operation which is expected to perform all local maintenance efforts on the loan fund sponsored equipment. In order to identify time purchase equipment when user departments call for PC repair, a label has been printed and placed on each time purchased system unit. On that label is printed a unique ADP equipment ID code, and the date maintenance is to expire (forty-two months from the date installed). When the campus technical staff repair a time-purchased PC they note the number on the label and forward the repair bill to the Office of Administrative Data Processing for payment. To this date this system has worked effectively. In the event the micro-computer technical department automates its inventory system, a bar code is included with the PC label.

In the last two years, an interesting spin-off from this loan fund has been observed. Being a public University, the campus departments are provided a fixed budget to be used during the current fiscal year. By state law, no campus account may have an end of fiscal year balance other than zero, except for specially approved revolving accounts. Positive balances in campus accounts are used to cover negative balances in other departments. It is left to the discretion of the director to see the departmental funds are appropriately used during the fiscal year. Upon the approach of the end of the fiscal year, campus administrators have traditionally scrambled to balance their department accounts. In years for which a surplus has been anticipated, this activity has meant the director had the luxury of purchasing some less essential items for the benefit of the department. In lean years this activity has meant a scrambling to find funds to cover departmental deficits.

Since the creation of the loan program, the departments on this campus, who have utilized our time payment account, have had greater flexibility in balancing their accounts. If they have monitored their spending activity judiciously enough to have an anticipated positive balance, some administrators have submitted an extra payment to the loan fund to pay for a portion or all of next year's PC obligation. Those directors who have been faced with a potential deficit have been allowed to place their PC repayment in hold for the current fiscal year. We have, therefore, seen a more creative form of departmental budgeting and have provided the campus with an alternative method for dealing with departmental fiscal year-end deficits.

To this date a number of the devices purchased during the first year of this fund have been paid in full. As they have paid off their time purchased equipment, some of the departments have purchased other devices, thereby keeping their departmental budget at a constant level while increasing the number of computers owned by their department. It was this very type of activity which had been envisioned when the loan program was initiated.

When this fund was created it was anticipated the PCs purchased would have no street value at the time of the loan maturity. It was not necessarily a pleasant thought, but one which the administrators of the fund felt at the time to be realistic. The advancement of technology during the last several years has been such that the value of most mainframe computers is a trifle portion of the original amount when the organization considers selling them in order to purchase newer machines. Considering the initial cost of Personal Computers, the expectation was the micros would have to be viewed as disposable. They would have no market value when the loan matured.

It came as a substantial surprise this last spring when it was realized the old PCs did have a value. With the introduction of the new IBM PS series computer, the old PCs suddenly seemed to have an identifiable demand. There were departments on campus who had desires for purchasing a micro-computer, but did not feel they had the funds to buy a new one. Since the Personal System computers were priced at nearly the same price as the PCs of two years ago, some of the current PC owners were interested in purchasing the new devices if they could sell their current PCs. It was in this manner the Director of Administrative Data Processing suddenly found himself cast in the role of PC broker. An amount of roughly one third of the original purchase price was established as the price of a fully configured used Personal Computer. Those departments wishing PCs were excited at the prospects of obtaining a computer at that price. To safeguard the used PC buyer, all used PCs have one year of maintenance paid on the machines. The departments owning the PCs were elated at the possibility of upgrading their equipment at nearly the same original cost with a bonus down payment from the sale of their existing PCs. While the sale of used equipment has not reached large proportions, it has been successful in the eyes of all participants.

After two and one half years of existence, this fund has purchased over $200,000 worth of equipment for campus administrative departments and has a balance of more than $18,000. With those funds the campus has purchased forty-seven Personal Computers, three terminal controllers, five terminal multiplexors, upgraded the memory of thirty PCs in one of the campus' PC laboratories and procured several other miscellaneous items for use in the campus administrative computing effort. The equipment on rent today has a purchased value of $112,000. With statistics such as this, one must conclude, this initial investment of $70,000 has been effective for the Rolla campus.

In reflecting back on the arguments submitted to fund this project, the following observations could be made:

1. Upon his arrival to this campus the Chancellor observed the lack of computer terminals in existence in administrative offices. He did not state a terminal on every desk as a specific goal, but made clear his desire to significantly improve the situation. Through the implementation of this fund, the Rolla campus has greatly improved upon the ratio of computer devices per staff member.
2. While the Chancellor who established the fund is no longer in office on our campus, this fund has been successful enough that when our three and one half years have expired the current Chancellor could reclaim a sizeable portion of the original investment and the fund would still have some purchasing power.
3. The departments utilizing this fund have been able to upgrade their office equipment configuration without requesting additional funding and not one of the borrowing departments have submitted a request for funds to purchase additional Personal

Computers from campus special interest funds.

Since the inception of this program, our campus administrative users have had two options for purchasing departmental computers. The first option (specially funded, one-time purchases), has the advantage of utilizing one-time appropriations and does not create a permanent commitment to the campus budget. It also provides the potential for a greater number of devices to be purchased in a short period of time. However, this option has the distinct disadvantage of not addressing the long term needs of the departments. This satisfies short term needs only. In the long run the departments so funded will return to the funding office again ... and again ... and again. They are created as parasites to the campus special appropriation funds. Potentially, they may never have their equipment configuration modified again.

The self funded loan program provides a slower equipment growth path than the special funding approach. It also means the department's budget is potentially endangered in years where campus budgets are reduced. The directors are potentially faced with the problem of how to pay for their equipment should they have their budgets reduced. However, the loan fund approach means the department has an avenue to upgrade their equipment in an orderly fashion over the years. They can creatively manage their departmental budgets by the judicious use of this fund. This program provides a much healthier environment for the campus budget as a whole.

In weighing the pros and cons of the two approaches, it is my contention the advantages of the self funded loan program substantially outweigh those of the one-time appropriations. There is a sense of risk involved in that the director must gamble the departmental budget will not be reduced during the next forty-two months. However, the alternative approach presents the risk that funds will be available in the future to fund additional purchases. This latter approach relies totally on the good fortune that extra funds become available when the department needs them and that some person of relevance on the campus will be benevolent enough to grant the department the money the next time. It creates a continual line of people asking for special funding favors from key campus administrators. Universities simply can not operate with a yearly line of administrators requesting special funding favors like indigent in a bread line. Campus budgets must be properly planned and judiciously administered. However, departmental equipment needs must also be addressed if the campus is to keep abreast of the increasing work demands from internal and external sources. With an initial variable amount of one-time funds committed from the campus, the loan fund approach provides for a better managed equipment purchase policy and allows the University the potential to recover the loan with time. The self funded loan program is an investment in the future and one which creates a more stable budget situation for time to come.

Track III

Organizational Issues

Coordinator:
Dennis Kramer
Ball State University

Papers in this track deal with the impact of technological developments on the organization of both individual units and the institution as a whole, and on the information delivery process.

Gene T. Sherron
Florida State University

Morell D. Boone
Eastern Michigan University

Michael Dolence
California State University/
Los Angeles

LEARNING RESOURCES AND TECHNOLOGIES: A UNIFIED ORGANIZATIONAL REORIENTATION TO ADMINISTERING EDUCATIONAL SUPPORT SERVICES

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ABSTRACT

A trend at many comprehensive universities is to centralize the administration of educational support services for many different reasons. In January, 1986, Eastern Michigan University (EMU) reoriented its administration of learning resources and technologies in support of its educational mission. A Dean's position was created to oversee the development of linkages between information and instructional technologies to the library, media and instructional support services.

This paper will include a description and discussion of EMU's approach to the administration of such services. It will cover the history, goals, mission and impact of reorienting the administration of educational support services at EMU.

Introduction

Historically, directors of academic libraries, media and computer centers have been responsive to student and faculty needs rather than proactive. The relatively new academic jargon "converging technologies" has brought to our attention a serious identity crisis concerning the traditional roles of these educational support services and their leaders. With the new information technologies needing to be merged with more traditional resources and services, who will do what regarding the administration of the evolution of these changing entities becomes a pressing question in higher education today.

This paper deals with this challenge and the initial attempt by EMU to address it. The first step in reorienting the information and learning technology administrative focus within the Academic Affairs Division was to appoint a Dean of Learning Resources and Technologies. This change, its mission, impact and implications will be discussed.

Background

The positions of "directors" of educational support activities as discreet activities are severely challenged by technological convergence much as the traditional teaching department "heads" are challenged by interdisciplinary courses. When a book was in a library and a film was in an A-V center and data were stored in the computer center, life was much more simple and understandable. With the promise of a totally integrated workstation having text, visuals and data ready for direct end-user interface, what happens to the administration of these resources and technologies?

There are data from a few technologically sophisticated institutions, such as Carnegie Mellon, indicating that there is movement toward a change in viewing support services as completely separate units to viewing information services and technologies as utilities. However, if this view of a new academic utility is to be successfully administered, the utility must be implemented effectively and efficiently for the maximum benefit of the end-users. In the beginning of this decade, those institutions which had been on the leading edge of accepting the challenge of this new vision had created a new administrative structure to deal with the increasing number of changes. This position has been given the generic label, Chief Information Officer (CIO). In 1986, Fleit published the first substantive look at the status of CIO positions in American Universities.[1] She has also been working with CAUSE and other organizations to help facilitate rational discussions about the need, strengths and weaknesses of having a simgle administrator over all information technologies. Chambers and Sprecher in their CAUSE '86 paper review current policies and organizational patterns as they relate to the converging technologies of computing, communications and libraries.[2] They note that there is a strategic planning process for information management in place within the California State University System. However, only at CSU, Chico, is there an organizational structure which encompasses the administration of library, media and computing activities under the direction of a single individual.[3]

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[1] L. Fleit, "Choosing a Chief Information Officer: Myth of the Computer Czar," **Cause/Effect**. 9, 1986, pp. 26-30.

[2] J.A. Chambers and J.W. Sprecher, "Policy and Organization of Computing, Communications and Libraries in Diverse University Settings," in **Proceedings of the 1986 CAUSE National Conference, December 1986, Hyatt Regency Monterey** (Boulder, Colorado: CAUSE, 1987) pp. 375-385.

Along with many other academic institutions, Eastern Michigan University (EMU) is trying to deal with most of the issues identified in the recent article on this topic by Woodsworth, Gapen and Pollack.[4] Their revealing 1986 Council of Library Resources funded study surveyed 91 institutions regarding the need to have information technologies managed in a more centralized fashion. One of their major conclusions was, "The lines between computing as a utility and information as a distinct service or commodity are blurring."[5] It should not be too surprising to the enlightened observer that a unified description of a CIO structure has not been found, nor does it look likely that there is a mad rush to copy any one particular model at this time. However, it is certain that faculty and students have a pressing need to utilize existing information resources and opportunities for increased utilization through the use of new technologies. The challenge is for administrators, librarians, media and computer specialists to work with these users of information services to develop a more integrated approach to information retrieval and use.

Institutional Setting

Eastern Michigan University (EMU), located in southeastern Michigan, is a comprehensive university with a current enrollment of over 23,000 students (17,000 undergraduates) and a full-time faculty of 680. EMU shares a history much like many state-supported regional institutions that began as teacher training schools. It has grown from a student body of approximately 2,000 in the early sixties, to one with ten times as many students and four colleges, in addition to the College of Education. Today, its mission still includes educating many of the public school teachers in the State of Michigan, but it also has become known for strong programs in applied technology, human services, business and the liberal arts.

Educational Support Services Prior to 1986

The organizational structure for administering the library, media services and computing has been similar to many other non-research oriented universities, the library and media services reporting to the academic side and computing reporting to the administrative side. This traditional structure seemed to have few campus critics as long as the library, media services and computing services remained suppliers of centralized, independent services. Over the years, non-print services moved from independence within the academic division to a somewhat uneasy merger with print (library) services. On the computing side, all seemed well as long as the central computing facility was mainframe-oriented and supplied adequate "computing power" to both the administrative and academic needs. However, the situation seemed to be changing at a rather alarming pace. The library, media services and computing were all being challenged to meet the demands of acquiring and utilizing new technologies while they maintain a high level of traditional services. That is, the library was to become computerized, offer computerized utilities and CD-ROM-based information systems. Media services was to be equipped to deal with the age of the satellite and interactive video. Computing was being challenged to deal with a more distributive-oriented, world centered around the microcomputer and telecommunication revolutions. Needless to say, the old segregated administrative structure was not able to deal with the age of technological convergence as well as it did with the age of discreet, reactive entities that did what they were supposed to do when they were asked to do so.

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[3] Chambers and Sprecher, p. 378.

[4] A. Woodsworth, D.K. Gapen, and K. Pollack, "Chief Information Officers on Campus," **EDUCOM Bulletin**. Summer 1987, pp. 2-4.

[5] Woodsworth, Gapen and Pollack, p. 4.

Prior to 1980, library and media services were administered by a director with department head status who reported to the Associate Provost for Budget and Personnel. Figure 1, page 9, upper left-hand corner, is a chart depicting the rather straightforward internal organization of the Center of Educational Resources (library and media services). During this time, the Computing Center's director (with department head status and reporting to the Vice President for Administration) was responsible for both administrative and academic computing on DIGITAL equipment.

In the early 1980's, the Instructional Support Center (ISC) was added to the organizational structure of the Center of Educational Resources. At first, there were only three components of the ISC - a language lab, a listening/ viewing lab and a tutoring assistance program. In 1983, a 70-station student microcomputer lab was added to the ISC facility and program. The micro lab was funded by the Computing Center, but it was to be administered and operated by the ISC. The Computing Center still kept to a mainframe approach (switched to IBM for administrative computing and dedicated DIGITAL equipment for academic computing). However, the Director was elevated to the rank of Executive Director (with dean's level status) and reported directly to the President, along with new executive directors for personnel, budget and auxiliary services. At about the same time, a new Provost was named and he asked the Director of the CER to report directly to him without a change in status.

Beginning as early as 1983, it became clear that the traditional administrative structures governing the information-based educational support services were not optimally responsive to the changes taking place, both changes internal to the institution and changes in information and learning technologies. It was an institutional given that the Executive Director of Computing would be the President's person regarding the traditional role of providing a predetermined level of computing services to the total campus community. However, it was the Provost's responsibility to formulate the requests for computing on the academic side and to directly administer the other educational support services already within his Division. This being the case, the Provost asked the Director of the CER to develop a plan for reorienting the administration of support services that directly impact on the instructional mission. What follows is a description of this plan (adopted by the Board of Regents in January, 1986), its impact and implications.

Learning Resources and Technologies (LR&T) -- 1986 -

The major problem addressed by the administrative reorientation was that the Division of Academic Affairs had no official representative to coordinate and develop the issues surrounding the appropriate application of instructional technologies. Specifically, the technologies involved are: computers as a tool within instruction and learning (CAI, CAL), and within the administration of instruction (CMI); television within instruction and learning (ETV), and as a product itself (telecourses); and electronic information as a tool (bibliographic data bases) and as a source (full text). Simply put, there was no administrator designated to deal with the critical question -- is the instruction being delivered, the learning taking place, the research being done, utilizing appropriate resources and technologies in the most beneficial and cost effective way?

To address this question, it was recommended that the responsibilities for coordinating, planning and developing a unified approach to the application of computer, video and electronic information within the Division of Academic Affairs be included within the mission of a reconfigured and renamed Center of Educational Resources administrative structure. The four fundamental assumptions behind the establishment of the Learning Resources and Technologies approach are:

- The coordination of the application of learning technologies need to be assigned to a single administrator within the Division who has appropriate expertise and experience.
- The Executive Director of Computing is responsible for the provision of computer and telecommunication services; however, he is not responsible for the specific applications of these technologies within the academic programs.
- New strategies must be developed to formulate a faculty-centered approach regarding the adoption and use of new learning resources and technologies.
- The existing educational support services (library, media, ISC) should be used to integrate these resources and technologies into their services in meeting the needs of their clients.

The revised mission of the reoriented organizational structure is to be more proactive in leading and serving its clients. With the barriers of administrative autonomies being erroded, it will be possible for educational support services to not only embrace new information and learning technologies, but seek to have them integrated into the instructional programs.

Figure 2, page 9, provides an outline of the LR&T organizational structure. There are two very significant changes in organizational structure.

The first is administrative -- elevation of the Director to Dean, establishing an Associate Dean for Library Operations and an Assistant Dean for Media and Instructional Support Services. These changes allow for a direct reporting relationship to the Provost, direct working relationship with the College Deans, liaison relationship with the Executive Director of Computing and assistance in managing the three service components. The second is strategic -- the creation of the Learning Technologies Development Unit. This Unit is the Dean's leadership arena in seeking a faculty-centered approach to the assessment, familiarization and development of appropriate applications of learning technologies. The Unit has three components -- the Center for Instructional Computing (CIC), the Center for Educational Television (CET) and the Center for Information Technology (CIT). Figure 3, page 10, is a description of the specific tasks outlined for each "Center."

At the present time, the Center for Instructional Computing (CIC) is the only Center which is funded and fully operational. The other two Centers are in the early stages of development. The CIC has been in the development stage since 1983. It became operational in January, 1986, when the LR&T was established. The CIC program was described in detail by the author and his colleague, the Director of the CIC, at CAUSE '86.[6] All three Centers are staffed by faculty on release time. Each Center has a direct link to at least one existing operational unit. That is, the CIC's activities are related to the ISC and the Computing Center; the CET's activities are related to Media Services; the CIT's activities are related to the Library and the ISC. Examples of current Center activities will be presented in the following section.

LR&T Impact

The reoriented structure has been in place for less than two years, but there are definite positive successes in both the operational and strategic administrative areas that can be attributed, at least in part, to the change in organizational structure. There are two major indicators of impact that can be identified at this early stage in the life of the LR&T structure. First, there is an objective indicator regarding the operational enhancements in quantifiable terms and terms of strengthened "shoelacing" of projects with the Computing Center. Two examples of these objective indicators of impact are:

- Library Automation Project approved and funded ($842,000) in July, 1987. General project direction is under the LR&T; however, funds for equipment and staff are being allocated to the Computing Center. The administrative structure of the project is a model of shared authority that will be used in other information technology projects in the future. Not only will all the library's clients benefit from this integrated online library system, but the system will also serve as one of the major data bases to be carried on the new EMU component of the MERIT NETWORK (hosted by the University of Michigan).

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[6] M.D. Boone and R.L. Ferrett, "Micros and Faculty: A Developmental Approach to Instructional Enhancement," in **Proceedings of the 1986 CAUSE National Conference, December 1986, Hyatt Regency Monterey** (Boulder, Colorado: CAUSE, 1987) pp. 491-498.

- o Micro Lab Expansion Project approved and funded ($180,000) in November, 1987. The Academic Affairs Division and the Executive Division are co-funding an expansion of the Microcomputing Lab in the Instructional Support Center (ISC). This will be the first general purpose PC LAN available to ISC clients. The LR&T and the Computing Center worked together to make this expansion possible. A side benefit of the project is funding support for the relocation and enhancement of the Media Services television studio and the College of Education's A-V Lab.

Second, there is an observable indicator regarding the strategic developments taking place within the Dean's role as leader of the Learning Technologies Development Unit. Seven examples of this subjective indicator of impact on the organization are:

- o Participate in the development of a strategic plan for academic computing resources by the Executive Director of Computing.
- o Coordinate EMU's participation in the University of Michigan based NCRIPTAL research project.
- o Co-sponsor with Wayne Intermediate School District learning technology showcase seminars for public school and higher education teachers.
- o Expand faculty development in the use of microcomputer-based instructional enhancement by creating a "mobile computer-projection cart program" for use in the classroom.
- o Conduct pilot projects with University Microfilms, Inc. in the use of new CD-ROM based information retrieval products.
- o Conduct pilot project with commercial data base utilities in end-user searching by students.
- o Produce videos showing innovative uses of information and learning technologies.

Organizational Implications

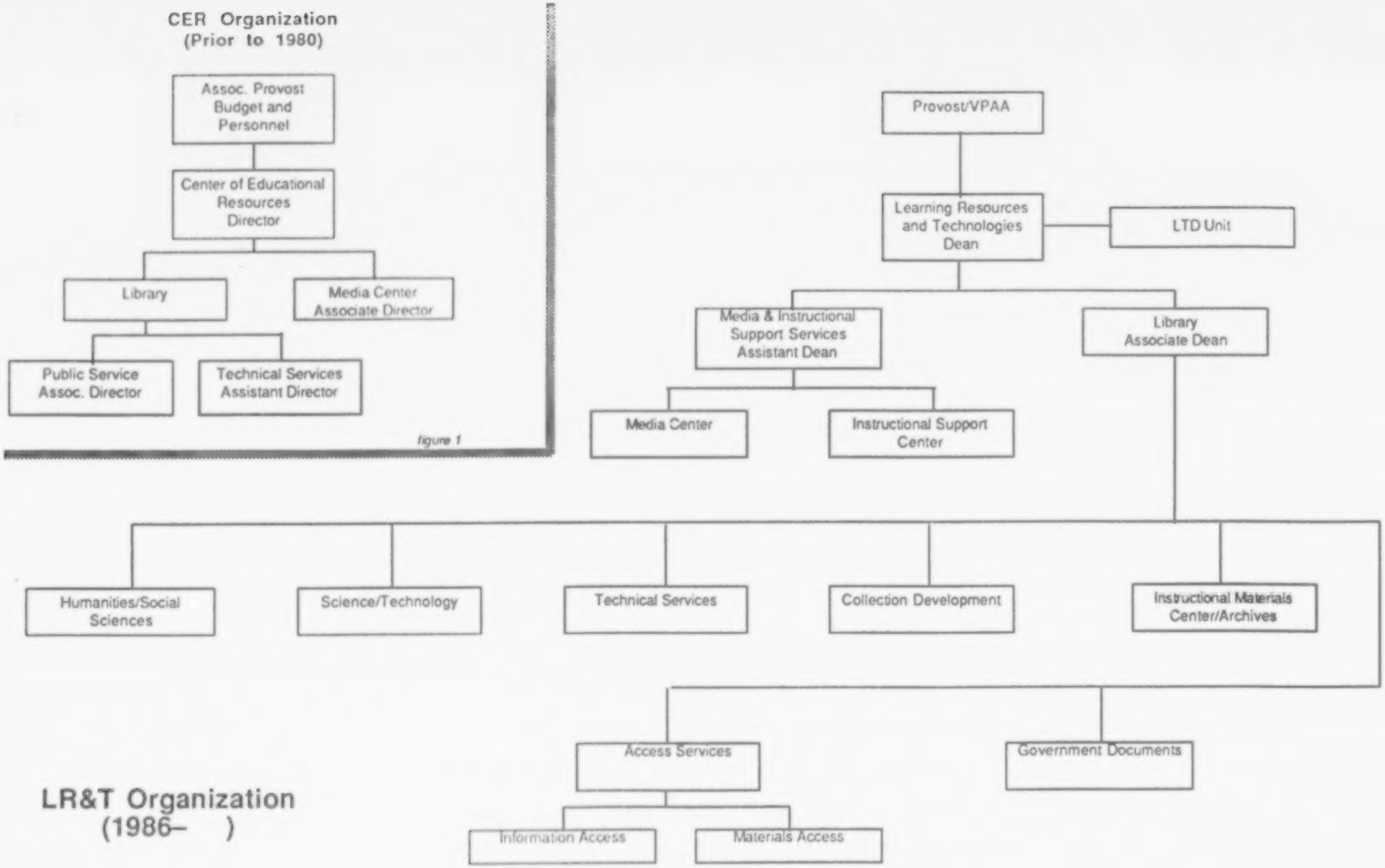
The organizational implications for the LR&T specifically and the University as a whole are too numerous and complex to cover in this paper. However, there are two very important related organizational implications that can be viewed as either inhibiting or accelerating factors affecting the unified administration of learning resources and technologies, depending on one's particular point of view.

- o Centralized Planning and Budgeting --
  At the present time, the processes of strategic and operational planning and budgeting are not conducive to a unified approach to learning resources and technologies. They have built-in inhibiting factors to accelerating the adoption of new technologies in support of academic programs and priorities.
- o Integration of Technologies with Academic Programs --
  In some cases, the long-standing tradition of college and departmental autonomy makes a strong case against a unified approach to learning resources and technologies assessment, planning, budgeting and implementation.

Both of these important organizational implications are behind the Provost's recent decision to form a division-wide educational technology task force similar to one that was formed two years ago to revamp the University's basic studies requirement. This is a very positive step in support of the new LR&T organizational approach.

Conclusion

Eastern Michigan University is attempting to adjust to the need for administering the "converging technologies" revolution. The approach described above is based on EMU's history, mission, political and economic environment. At best, it is a transitional structure, but it is one that has been put forward to reorient the traditional reactive support services model. The reorientation of the administrative structure is a proactive attempt at improving the organizational response to meeting the challenge of providing opportunities for increased utilization of learning resources and technologies by faculty and students.



CER Organization
(Prior to 1980)

Assoc. Provost Budget and Personnel
Center of Educational Resources Director
Library
Media Center Associate Director
Public Service Assoc. Director
Technical Services Assistant Director

figure 1

LR&T Organization
(1986–)

Provost/VPAA
Learning Resources and Technologies Dean
LTD Unit
Media & Instructional Support Services Assistant Dean
Library Associate Dean
Media Center
Instructional Support Center
Humanities/Social Sciences
Science/Technology
Technical Services
Collection Development
Instructional Materials Center/Archives
Access Services
Government Documents
Information Access
Materials Access

figure 2

LEARNING TECHNOLOGIES DEVELOPMENT UNIT

Center for Instructional Computing
(CIC)

- Develop and administer a program of both academic year and Spring/Summer workshops on instructional computing for EMU faculty members.
- Publish a CIC Newsletter featuring brief descriptions of current instructional computer usage here at EMU, along with abstracts of significant journal publications on classroom computer usage.
- Plan and coordinate a program of "sharing successes" discussion sessions for the in-house exchange of ideas among EMU faculty members on instructional computing topics.
- Coordinate, in liaison with University Computing, the ISC and other appropriate university groups the most efficient instructional usage of available academic computing hardware and software.
- Coordinate and administer a small program of competitive faculty grants for research on instructional computer usage at the university level.
- Stimulate and coordinate the writing of grant proposals and the seeking of private support for major divisional instructional computing projects.
- Develop a CIC network of departmental CIC liaisons, plus provide support for the development of software by faculty.
- Coordinate with other Centers the planning and implementation of programs integrating the use of various technologies.

Center for Educational Television
(CET)

- Develop and administer a program of workshops on various facets of educational television usage, including such topics as the in-house production of TV courseware, and the preparation of wraparound materials for courses in which commercially available telecourses are to be used.
- Coordinate, in liaison with Continuing Education, the appropriate college(s) and Media Services, the planning and scheduling of ETV courses.
- Coordinate and administer a small program of competitive faculty grants for the development of ETV courses and/or TV-based instructional modules.
- Coordinate with the other centers programs integrating the planning and implementation of the use of various technologies.
- Publish a CET Newsletter featuring brief descriptions of current educational television usage here at EMU and elsewhere.
- Stimulate and coordinate the writing of grant proposals for major divisional ETV projects.
- Develop a CET network of departmental CET liaisons.

Center for Information Technology
(CIT)

- Develop and administer a program of workshops to familiarize faculty with the full range of capabilities of today's electronic information technologies as general components of the teaching and learning process; i.e., teach faculty how to use information in the preparation and design of their classes, and how to teach their students to make appropriate use of these technologies.
- Publish a CIT Newsletter to stimulate greater awareness of research and applications in the field of pedagogical use of information technologies.
- Coordinate and administer a small program of competitive faculty grants for the development of information-based instructional modules.
- Coordinate with the other Centers an integrated program utilizing the various technologies.
- Coordinate in liaison with the Library, appropriate colleges and other appropriate university groups, the most efficient use of electronic information technologies in suppport of the instructional program.
- Develop a CIT network of departmental CIT liaisons that will provide for a sharing of successful applications and uses of electronic information services.

Figure 3

CAUSE 87

IRM a Short Lived Concept?

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ABSTRACT

The evolution of computing organizations has progressed steadily over the years. During this decade, with the convergence of computing and communications, information resource management organizations with policy level leaders have multiplied significantly. Typically, these new organizational units consist of departments and functions of long standing, pulled together under the umbrella of a chief information officer. In the next few years, as fully integrated networks, decision support systems, expert systems, and distributed database management systems become a reality, a continued organizational evolution is likely. This paper explores some of the causes of change, outlines some of the possible changes, and speculates about the characteristics of the next stage of organizational development.

Introduction

The principal irony of the information age is that while business, industry, education, and government invest rapidly and heavily in equipment, software, and systems to more effectively manage their information resource, investments in and attention to organizational change required to fully utilize and sustain these new capacities is slow and poorly understood. Nonetheless, the age of information will continue to evolve and develop. One scenario describes the next developmental stage as knowledge management.

> A close and direct relationship exists between information management (the ability to manage information and supporting technologies to increase the value and use of this resource) and knowledge management (the ability to search for, have insight into, analyze and synthesize questions, problems and alternatives to resolve or solve significant needs, concerns and interests). [1]

Even though the distinction between information management and knowledge management may appear academic to some, the direction of evolution is clear. A rapidly unfolding movement toward more individual power to acquire, store, organize, manipulate, retrieve, transmit, and display information is significantly expanding the knowledge base. The information economy we are in today will continue to drive this evolutionary movement.

Such an evolutionary path is not smooth but unfolds in convulsive advances evident in a number of major information trends.

10 Information Megatrends Impact Education [2]

Strategic Networking: The exploding area of systems integration is focusing on merging networks of systems into a hypersystem or "Information Utility" of the future. This is a strategic move to close the gap between computing and communications in order to bring about compatibility among incompatible systems. This "anything talks to anything approach" eventually will make available to users (regardless of access port) the power of all the combined resources of the hypersystem. The Information Utility, therefore, becomes the electronic nervous system linking processors, mainframes, minicomputers, microcomputers, servers, local area networks, and a vast array of functional peripheral devices.

The advent of this Information Utility will provide university users directly with sophisticated tools to meet more and more of their information needs. This fluid, continually changing system will foster increased expectations and demands for information technologies. It will further increase the reliance on digitally stored and transmitted data, voice, and image--both on and off campus. It also will decrease the reliance on sheer volume of stored numerical data, as well as reduce data redundancy, and require an integrated systems philosophy.

The linking of local area networks and wide area networks will continue to expand ties to widening geographic areas by providing electronic communication and other services on a global scale. For education, the result is scholarly networking which will remove geographic barriers to intellectual interchange and dissolve discipline-based isolation, fostering global scholarship on a basis of dynamic international networks. The continued evolution of the information society will forge new dynamic linkages between universities and business, industry, and government.

Commercial Globalization: Technology has spawned significant increases in international trade. As a result, the "Global Marketplace" has emerged as a given in all areas of commercial endeavor.

Competition has increased in both quantitative and qualitative terms forcing large and small producers and suppliers of goods to meet unprecedented challenges of scope and complexity. This continued trend will increase the demand for skilled, knowledgeable graduates in areas involving international trade. The universities of tomorrow will also face increased competition for student markets that they have historically had to themselves. These markets can be expected to shrink as the number of competitors for a given student increases. For other institutions, expansion into the international student market and attracting more students by investing in technology will secure their enrollment future. Decreases in traditional enrollments and funding for education will continue to require greater administrative control and productivity.

Corporate Consolidation: We already have begun to see the emergence of a two-tiered vendor environment with a comparatively small number of large corporations accounting for most of the business volume and a large number of entrepreneurial firms accounting for the majority of product innovations. The divestiture of AT&T will continue to result in incremental increases in telecommunications costs. It also will continue to encourage the development of fourth generation digital telecommunications systems with vastly expanded features and growth capabilities for the full integration of voice, data, and eventually video. Since divestiture, AT&T has entered the computer market, and IBM has acquired Rolm and entered the communications market. The dynamics of both computing and communications have entered a new era.

Operational Integration: Traditional bureaucratic barriers between the departments of large organizations and their personnel will weaken. Instead, organically functioning, continuously interactive, electronically linked operational units will pursue overall organizational goals. There will emerge a single data structure for the organization. There will be information at the work group level, department level, and institution level.

In concert with corporate consolidation, there is a continued trend toward the merger of previously separate entities. Postsecondary institutions will need to maintain state-of-the-art information technology that is both appropriate and necessary for highly integrated organizations. However, the resulting infusion of these technological advances will require extensive professional development of faculty and staff.

Management of the educational enterprise will continue to be enhanced. Relational data bases, fourth and fifth generation tools, and integrated systems that meet the depth and breadth of institutional needs will continue to improve the quality of management and help to maximize the deployment of scarce resources through operational integration.

Management Realignment: As the integration of the information system into the corporate mainstream occurs, the roles of professional managers will change from builder/operator/ maintainer to architect. The decision-making capability and power of mid-management specialists will broaden. Top echelon management structure will be simplified, and automation will reduce entry level management jobs.

Automated Expertise: Driven by increased hardware capacity, software developers will continue to make available increasingly powerful software tools. Very soon this will include artificial intelligence (AI) utilized in very practical ways. AI oriented software will become widely available, and expert support systems will become commonplace. The ability to manipulate symbols, deal with uncertainty, and use rules and inferences to solve practical problems and simulate human intelligence will continue to drive increasingly sophisticated AI applications.

User Sophistication: Steady demystification of technology will continue to decrease intimidation. As demystification occurs, user sophistication will increase. Increased sophistication will increase constituent expectations. There will be a significant increase in user technical proficiency and productivity through education and broadened experience. In a relatively short time, esoteric sophistication will be rendered unnecessary by the availability of increasingly "user friendly" products. This will require expanded technical and consultative support.

Consumer Expectations: With the decrease in consumer intimidation, the public's expectations and demands for excellence in both products and services will escalate steadily. There will be an increasing impact of information technology upon curricula and the teaching and learning processes themselves. Introduction of computing tools in the elementary and secondary schools will give rise to a significant increase in the expectations of available technologies among students. The issue of technology availability also will continue to be a factor in attracting and holding top scholars. Discipline and institutional forces will drive the need to provide each faculty member not only with a workstation but a full toolchest. Curricular realignment will be required as the top scholars use technology within and across disciplines and redesign curricula to incorporate its use. Disciplines that have significant alignment with business, industry, or government will need to realign curricula in order to produce graduates who are literate and current in their fields. Ethical and legal issues regarding the uses of information technology have been neglected and will demand increasing attention by the institution as the economic value of information increases.

Reoriented Distribution: The public will demand prompt, if not instantaneous, service and product delivery. Significant growth in vendor-owned, electronically supported distribution systems (along with erosion in third-party distributors) will occur. "Information brokers" will emerge as an integral part of the economy. Libraries will continue to have increasing demands for automated library services, including ties to internal and external networks. In education, technology will continue to de-institutionalize the learning and scholarship process. Computer-aided assessment will provide the greatest opportunity for significantly increasing the amount and quality of individualized student attention.

Technical Redirection: The conceptual parameters of information technology will finally have been established. Technological advances will continue to result in a merger of various technologies including computing, word processing, telephone services, data or text transmission, media, and possibly copy services. Hardware capacity will continue to grow, providing increases in computing power and storage capabilities. These will drive further development and expansion of academic and administrative workstations to encompass word processing, microcomputing, and intelligent terminal capabilities. There continues to be a rapidly expanding introduction of new video devices connected to computers that provide higher-resolution images, animation, audio, and video, as well as low-cost, graphic hardcopy. Users will direct energies toward creative optimization of existing equipment and concepts rather than delay action in anticipation of revolutionary breakthroughs. Increasingly, computer-intensive environments will utilize greater central resources as well as more microcomputers. However, central resources will shift from delivering products to optimizing systems and capabilities, while distributed microcomputers will provide more immediate computing power to individual users and departments.

The rates of change in hardware and software and the advent of converging technologies will require continued institutional attention to training/education for information technology literacy defined in terms of specific disciplines and levels of staff responsibilities.

Information Organizations

The megatrends outlined above will shape the organizations of the future. Significant strides have been made in the effective and efficient management of information. These are attributable primarily to the recognition that information is a basic resource. Within this context, both the content and the technology required to deliver the information is managed. Accordingly, such management more and more frequently is charged to a chief information officer (CIO) who must be knowledgeable about the primary enterprise of the organization and have some background in information systems technology.[3]

Defined, Information Resources Management (IRM) is the management (planning, organization, operations, and control) of the resources (human, financial, and physical) concerned with supporting (developing, enhancing, and maintaining) and servicing (processing, transforming, distributing, storing, and retrieving) information (data, text, and voice).

Appropriately, the first stage in implementing an IRM organization, after establishing a CIO, is to pull together the diverse functions surrounding the management of information. These new heterogeneous organizations must concentrate on consolidating form and function while building a comprehensive information strategy and supportive information infrastructure.

A number of challenges face the development of a new IRM unit. A change methodology must be implemented which facilitates transition from a group of diverse units to an IRM organization. The methodology must involve the development of an understanding among the existing management team of the purpose and theory behind implementation of an IRM program. Next, a planning model must be adopted. Planning must focus on the identification of the functions that IRM needs to perform. Old units then can be reshaped into new IRM components based on identified functions. The results of this process should be summarized in an IRM Strategic Plan and circulated for review.[4]

The success of IRM planning can be enhanced by soliciting broadbased participation in the planning process and providing integration of the IRM plan into the campus Strategic Plan. A recognized need to improve the decision process can be addressed by ensuring that decisions are made in a timely manner, at the most appropriate level, and with a view to the interests of the institution as a whole. Human resources development extends beyond the efficient and effective use of existing resources to the cultivation of an IRM organization "culture." The successful implementation of IRM means not only a major commitment to improve the quantity and quality of services, but also to maintain an alignment between services that are needed and those that are actually provided. This is ensured by establishing of evaluation mechanisms. Smooth development and operation of broadbased IRM support systems such as telecommunications, broadband networks, and central computing systems also must be supported by IRM unit goals and objectives. Through this stage, the new IRM organization usually maintains many of the traditional hierarchical characteristics of its component parts. At this time, most IRM organizations in higher education find themselves at this stage in development.

Hierarchical characteristics include many organizational levels, integrated vertically, controlled by layers of management exercising authority over relatively homogeneous enterprises. This layered organizational architecture emphasizes a chain of command; therefore, any given manager is focused on the layer immediately above or below rather than on the environment. Information flows up and down the corporate ladders being re-interpreted, filtered, massaged, and passed on at each level. Such, organizational culture stresses that the organization is only as strong as its weakest link, causing the development of risk-averse behavior. This rigid structure determines enterprise strategy bounded by narrow spans of direct control designed to maintain the status quo. [5]

Transitional Forces

There are many parallels between the development of information organizations in business and higher education. The development of the global economy with increased competition and its squeeze on corporate profits first drove businesses to rethink the hierarchical structure. Layers were removed to conserve resources. At the same time, rapid developments in technology began to allow the span of communication to replace the span of control. In order to increase effectiveness and efficiency and thereby maintain a competitive position, bureaucratic, hierarchical, information-dependent organizations have had to evolve.

Similar forces (scarce resources, technological developments, changes in mission) are driving the evolutionary process in higher education. The development of IRM organizations in over 200 colleges and universities reflects this trend. The path is shaped continually by the impact of new and developing technology spawning greater functionality. Technology permits wider access to data; more power to shape data into organized information; easier, more rapid communication with colleagues; direct user control over output; and more rapid passes through "what if" loops. Effective users rapidly increase their value to the success of the organization and emerge as the pacesetters. The success of these power users creates an aura of status around possession of technology. Status seeking may well precede need as a determining factor driving technology acquisition and should not be underestimated as a powerful force affecting organizational evolution.

One of the most important evolutionary anomalies is the concurrent development of a single corporate data philosophy and data structure while encouraging the distribution of the data itself. The resulting distributed data base system consists of a collection of sites, linked via a communications network. Each site maintains a data base system of its own and cooperates with other units so that a user at any site can access data located at any other site, as if it were their own. [6] To take full advantage of the distributed data base strategy and realize the potential benefits requires (soon to come) truly distributed relational data base management system software.

The advent of decision support systems (DSS), integrated networks, distributed data base systems (DDBS) and expert systems will continue to cause organizational reorientation. Expansion investments and increases in the numbers of users have led to the development of: 1) a decentralized corporate technology managed centrally, 2) the need for a standard application architecture, 3) the need to accommodate and integrate an expanding array of technologies, 4) the need to support applications at each organizational level--institution/school/department/individual, and 5) the need for a comprehensive organization-wide computing/ communications strategy and infrastructure.

Organizationally, this mandates the role of data administration. The need for this function first became apparent as data base management systems, managed by technically-oriented data base administrators, failed to foster data independence, control data redundancy, provide system integration, and facilitate the level of information sharing that organizational functions required. [7]

The continued development of artificial intelligence will influence the evolution of information organizations. We have moved beyond just the AI concept and are seeing important practical applications in education. Knowledge-based front ends designed to improve and increase service such as bibliographic retrieval systems and a variety of help functions, will smooth the incorporation of technology into the enterprise. [8]

Along with the intended developmental outcomes cited above, there also are unintended and unexpected outcomes with the increased use of technology on campus. One example is the converging of computing and communications coupled with the continued impact of divestiture, which puts the institution in the business of being its own telephone company and further mandates that it service data (and even video) needs as well as voice communications. Another example is the social impact evolving from the incorporation of technology into the workplace, producing fears, phobias, anxiety, and frustration among new or non-users over learning the use of these new technologies. [9]

Technology also changes communications patterns especially between strong computing and communications users and non-users. Many basic job functions have been affected as individual workstations are substituted for typewriters, filing cabinets, copying machines, calendars, and, in some cases, partial replacement for the telephone and mail. These replacements have deep impacts on traditional support staff fostering a user/non-user hierarchy and fading the lines between clerical and professional ranks. Among the most profound impact is the changes in standards by which work effectiveness, efficiency, quality, and quantity are measured. The use of technology causes a shift--non-user output is compared with and in some cases competes with user output. These changes are evident in the shift in focus from maintaining the elite technocracy to empowering the user with increasingly sophisticated tools and services.

A New Model

One result of these transitional forces may be the emergence of a networked organizational structure. A networked structure is characterized by fewer organizational levels with a wider span of control, horizontally integrated, adopting a flexible operating style designed to respond to a variety of strategic possibilities. The fundamental feature in these new organizational environments is their interconnectedness.

> These interconnections and interdependencies did not develop slowly, one step at a time, ...rather, their emergence is ... of instantaneous networks forming to link historically separate and autonomous agencies, organizations and institutions. [10]

Since the evolving network organization is more strategically focused, it encourages significant involvement with the outside environment. Operating in a matrix, the network approach is more flexible, encouraging a blend of organizational units and crossing organizational barriers, permitting the strategy to determine the operating structures. Success is measured more by the degree of progress toward meeting strategic goals than by interaction with levels above and below each operational level. An orientation toward achieving goals fosters a more self-disciplined culture with broader understanding of organizational purpose and environmental parameters, thereby recognizing rapid change in the environment. These evolving characteristics are in stark contrast to traditional hierarchical structures that support a static environment. The matrix structure permits a contingency approach to management, permitting the more effective targeting of resources, the possibility of eliminating overlap and duplication, and the fostering of a focus on strengthening weak areas. [11]

A responsive network organization recognizes the value of smart risk-taking coupled with planned change. Technologies alone cannot make an organization successful. Both the personal and technological networking must foster a collegial environment. The developed Information Utility will provide an infrastructure to support a mix of services and products, place emphasis on client involvement, provide education and training for a standardized "tool box" of applications, stress the participatory prioritization of services, provide maintenance for the campus network and associated standardized devices, and lead the strategic planning for information resources.

As organizations transition to a networked structure, a new culture will develop. The new culture and philosophy will contrast with the current IRM environment in several ways (Figure A). The new organization will concentrate on optimizing information as a resource rather than legitimizing its emphasis and support. The focus on information technology will become organization-wide rather than on IRM organizations integrating information functions. Organizations will focus on meeting strategic goals by applying technology rather than increasing functionality by melding technologies. IRM staff will begin to shift from doers and helpers to designers and consultants. Acquisition will focus on why the organization is buying technology rather than on what is being bought. Responsibility will shift to all organizational managers sharing responsibility for information technology rather than responsibility being that of IRM alone.

Figure A: Comparison Between Early and Late IRM Culture

EARLY IRM CULTURE	LATE IRM CULTURE
Legitimizing Information as a Resource	Optimizing Information as a Resource
Focus of Integrating Function within IRM	Focus on Integration of Information Technology Organization-wide
Increases in Functionality by Melding Technologies	Focus on Meeting Organization Strategic Goals by Applying Use of Technology
IRM Employees as Doers and Helpers	IRM Employees as Designers and Consultants
Focus on What You are Buying	Focus on Why You are Buying
IRM Organization Responsible for Information Technology	All Organization Managers Share Resonsibility for Information Technology

Transition Strategies

Transition strategies require a clear and concise idea of the target environment. They must be politically sensitive, factually based, and technologically sound. Managing knowledge resources must expand to become a central theme of institutional administrative philosophy. In this model, the role of the Chief Information Officer will parallel that of the Chief Financial Officer (CFO). Like the CFO, the CIO will be a senior level policy officer sharing the responsibility for both setting and accomplishing the strategic goals of the organization. The CIO will lead strategic information planning, oversee information technology investments, manage the information infrastructure, and maintain information accountability. Line managers throughout the organization will be expected to effectively and efficiently use information technology just as they are expected to be fiscally responsible.

For this to come about, management must be re-educated about the strategic and operational role information plays in the continually emerging knowledge economy and in the organizations of the future that will flourish in it. The education program must emphasize the acquisition of new skills to appropriately use information technology and impart a sense of urgency about the opportunities arising and the consequences of not seizing them. As organizations are reshaped by strategic decisions, the role of all managers is reshaped by the demand to deal with, manage, and capitalize on information.

Strategic Decisions

> The key concept to keep in mind when planning for new technology is that the development of an information system is a strategic decision, not a technological one. [12]

The information system crosses all organizational boundaries and penetrates to every organizational entity, and its impact on organizational effectiveness and efficiency is profound. In the new model, there is an increased dependence on and penetration of information technologies into the strategic, operational, and managerial decision-making processes throughout every level of the enterprise.

Information systems add value to decision-making by being easy to use (physically accessible, and easy to find and format), limiting irrelevant information (appropriate, selective, precision), providing quality information (accurate, reliable, valid, comparable), increasing adaptability (flexibility), and saving time and cost. Information systems also allow this value to be put where most decisions affecting an enterprise are made. New information systems can help target decision-making on meeting strategic goals if managers at all levels assume and accept responsibility for their decisions in this context, rather than the context of serving parochial unit interest.

Once this occurs, the organization is reshaped into an adaptable, flexible, networked organization with significantly enhanced strategic response capabilities.

Conclusion

Reflecting on the fundamental purpose of IRM organizations -- to facilitate and provide for the effective and efficient use of information as a basic organizational resource -- it is clear that the principles of IRM will not change much in the forseeable future. Current IRM organizational structures, however, may well change radically.

The four cornerstones for establishing an IRM program which have served its development so far -- 1) defining the IRM concept in the context of the organization, 2) establishing governance, 3) developing a strategy that defines the organization's unique information architecture and articulates the desired information environment, and 4) establishing the appropriate level of technology standards -- will continue to allow the desired environment for information resources to be realized. [13]

Without question, the information resources management environment will continue to evolve. The evolution will take place in a future dominated by the 80/20 rule--80% of what anyone does can be done equally well by anyone else--future success depends on our ability to develop the other 20%. The new competition will be one of ideas, concepts, and visions; it will be oriented toward the future; it will be interactive and on-line; and it will require innovative learning and a creative, effective response to change. Management in this new era will be in the open, and power will be redistributed to those who have access, down to the individual and small group level. Institutional missions will change, management will change, information skills required to meet these new evolutionary challenges will change. There is no longer any such thing as a predictable 25 year career path.[14]

The authors believe the emerging organizations will be networked ones. They will facilitate change, capitalize on information, employ more self-actualized, empowered workers who are closer to decision-making. They will be future-oriented, meeting to discuss what worked rather than what went wrong. For this to happen the change process and the orientation to the future must be internalized. It is clear for this transition to occur management at all levels need to rethink their roles in the organization, reassess how they do their job, adjust their attitudes toward change, and equip themselves with new visions, strategies and methodologies of implementation.

Is IRM a short lived concept? We don't think so.

Bibliography

1. Marchand, Donald A. "Information management: strategies and tools in transition." Information Management REVIEW, Summer 1985, pp. 27-34.

2. Ewing, Tom, "10 MIS MEGATRENDS: A Road Map For Strategic Planning." Information WEEK, 19 January 1987, p. 26.

3. Forgionne, Guisseppi A., and Willits, Stephen D. "Effective delivery of management technology." Information Management REVIEW, Summer 1987, pp. 59-70.

4. Penrod, James I., and Dolence, Michael G. "IRM in Higher Education: A Case Study." Information Management REVIEW, Fall 1987, pp. 9-22.

5. Drake, Rodman L., "Innovative Structure For Managing Change." Planning Review, November 1986, pp. 18-22.

6. Date, C.J., "Twelve Rules for a Distributed Data Base." Computerworld, 21 (23) 1987, pp. 75-81, .

7. Tillman, George. "Why data administration fails." Computerworld, September 7, 1987, pp. 73-76

8. Mecklenburger, James A., "Expert Systems: The Next Technology Breakthrough for Education." ELECTRONIC LEARNING, September 1987, p. 6.

9. Muffo, John A., and Conner, Mark E., "Unintended/Unexpected Outcomes of Computer Usage in Higher Education." Unpublished Manuscript.

10. Luke, Jeff S., "Managing Interconnectedness: The NEED FOR CATALYTIC LEADERSHIP." Futures Research Quarterly, Winter 1986, pp. 73-83.

11. Barone, Carol, "Converging Technologies Require Flexible Organizations." CAUSE/EFFECT, November 1987, pp. 20-25.

12. Kooser, William W., "Taming Technology." TODAY'S OFFICE, June 1987, pp. 65-66.

13. Ray, Mel, "Information resources management: four cornerstones for implementing IRM." Information Management REVIEW, Fall 1986, pp. 9-15.

14. Hallett, Jeff, A keynote Address to the CASE Institute on the use of computers in advancement. Boulder Colorado, August 2, 1987.

"ORGANIZING TO MANAGE INFORMATION RESOURCES"

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ABSTRACT

The 1980s will be remembered for its personal computers, supermicros, supercomputers and a deregulated telecommunications industry. And, on the management side, we have been blessed with chief information officers (CIOs), computer czars, and information resource management (IRM).

No doubt these new concepts were necessary and are timely to recognize that functional areas have grown much larger than DP, ADP, and MIS. But, what do we know about it? WHY has this happened? Was it because of the micro invasion or deregulation or the "information wave"? Yet, maybe the more important question is WHAT is IRM and WHO are these CIOs?

The integration of the various information technologies has become today's **restructuring** rage. And, colleges and universities have been changing their management structure in recognition of the need to deal with these burgeoning technologies. This paper is structured to review the various organizational implications of a broadened technology scene and a recognition that **information** is a resource that will now be managed from a much higher level.

Highlighting the paper are two "studies" on CIO positions in higher education. Finally, a case example is provided to indicate how Florida State University is organized to manage its information resources. In both instances, comparative data are presented to allow others to deduce how their organizational issues may be resolved.

From DP to IRM

Over a span of more than thirty years, we have called our computer boss by the title that most approximated the name given to the industry, at that time. Let us take a look back to see how we went from **DP** to **MIS** to **IRM**.

In the 1950s, when tabulating equipment was used by the accounting department, we began to call him the **DP Chief** or the Chief of Data Processing. And, even when PCM or punched card machines became the peripherals on either end of those newfangled computers, it was still DP.

By the 1960s, we evidenced a bit of sophistication and called our business **ADP** or Automatic Data Processing. Funny thing is that we all new then as now that there is nothing "automatic" about this computer business. We began talking about **information systems** so the "Director" of Information Systems title began to emerge in the latter part of the decade. As a post script to that decade, the Federal government adopted the name **EDP** or Electronic Data Processing.

The 1970s, with **MIS** or Management Information Systems and DDS or Distributed Data-processing Systems, broke the mold of centralized computer center and function. Now, the head guy became the Director of MIS. And another thing happened in the 1970s, we began to see some lady directors join this elite group of computing managers.

In the 1980s there emerged a new but higher level of administrative position endowed with broad responsibilities for information systems, computers, telecommunications, and technology in general. The title given to this position varies from **Information Resource Manager** to **Chief Information Officer** to **Computer Czar.**

But, WHAT does it mean? WHO are IRMs? WHEN did we start using these terms? WHERE do IRMs fit in the organizational structure? And, WHY? WHY do we need yet another acronym to label the same old function?

The Capsule News Lead

IRM. Information Resource Management. Its new. Is it NEWS? Well, let's suppose it is. So, let's give it the journalist's treatment. For an outline concept that will help us understand this topic, the tried and true **capsule news lead approach** of "who, what, when, where, and why". With this structure, we can logically explore the subject "**Organizing to Manage Information Resources**".

WHAT is Information Resource Management?

A little "editorial license" is needed at this point. It will make much more sense to start with "what" IRM is as a function rather than "who" an IRM is as a position. But even the "what" is not so easy.

A review of over fifty publications on IRM reveals that there is no accepted or standard definition of the term. Surprised? No, we have come to live with such facts. Recall that MIS never received a simple definition so why should IRM be any different.

This leaves us with no option but to check over the literature and see what people are saying. In building a definition, there is a normal tendency to first describe a **philosophy or concept** and then identify its **components.** For our philosophical underpinning, let us go back to Toffler.

Alvin Toffler (1980) reminds us that a **new** civilization is emerging in our lives.[1] Toffler describes his **Third Wave** of societal change as the **Information Revolution.** Suggesting that this "wave" began in the 1950s, it has brought with it the widespread use of computers and even changed the way we work. In this century, we have gone from factory workers to office workers to **knowledge workers.**

We find that management of this knowledge worker, the new technology and this new **information resource** is basically management of permanent change. New concepts, issues, and notions remind us that revolution means "change" and new challenges mark our daily lives. The conceptual response has been to recognize information as a **resource.** Many management textbooks now make **information** the fourth resource added to the traditional list of "men, money, and material". In 1979, John Diebold stated that "the organizations that will excel in the 1980s will be those that manage information as a major **resource.**[2]

To get a flavor for this "information as a resource" concept, consider these definitions:

> At one level, IRM manages information as an organizational resource similar to capital and personnel. In this sense, IRM is a philosophy that is directional in nature. At a second level, IRM incorporates information services in the traditional sense--communications, office systems, and such informations components as records management, library functions, and technology planning.[3]
>
> IRM is the management of the data, people, and processes that produce information that serves a business or functional need. IRM focuses on embracing productivity within a corporation by taking a comprehensive view of systems development. A key feature of IRM is centralized control of information resources.[4]

Notice what is implied in IRM. As a **philosophy** or **concept**, we can detect the emphasis on management, the shift in perspective from data to information to all information resources, and that information is being viewed from a higher level in the organization.

> The various components of **IRM** include human resource management, hardware and software management, telecommunications, office automation, and information systems.[5]

The list of **components** that can be derived from these definitions suggest that the CIO will most likely be responsible for:

--Computer Technology,
--Information Systems,
--Telecommunications, and
--Knowledge Workers.

Over and above some of the components contained in these definitions, universities have added some that tend to be unique to higher education. Some of these CIO's responsibilities include such broad information services areas as: libraries, printing operations, mail services, instructional (media) resources, bookstores, and the like.

And, to get the flavor of the responsibilities to be performed, the CIOs tend to be involved in:

- --Strategic Planning
- --Operational Planning
- --Policy Formulation,
- --Capital Budgets,
- --Operating Budgets,
- --Negotiations with Vendors, and
- --Major hardware/software purchases.[6]

WHO! The Chief Information Officer

Let's use a few word pictures to give the flavor to this **Chief Information Officer** or **CIO** character.

> **Planner** and **architect** of the organization's information resources.
> **Manager** of the organization's vital information resource assets.
> **Promoter** of information technology throughout the organization.
> **Watchguard** of the corporation's investment in technology.
> **Communicator** of technological change.

With that heroic introduction, we move on to the issues of the title, the organization level, and the skills of the position.

Synnott and Gruber (1981) wrote one of the early books on IRM, in fact that was the title--Information Resource Management. In it is found one of the most comprehensive descriptions of the role and responsibilities of the CIO:

> Chief Information Officer (CIO)--a senior executive responsible for establishing corporate information policies, standards, and procedures for information resource management, and for identification, collation, and management of information as a resource.[7]

It was recommended that the CIO in an organization operate at a highly senior level, but at the same time share power with other managers responsible for the control of information in subdivisions such as computer centers, communications units, and information systems.

In the early 1980s when this position was being discussed and described, it is hard to establish whether people first focused on the **function** of Information Resource Management or the **position** of Chief Information Officer. However, it is clear that the decision-makers had decided that there was a large technology function that needed to be managed. And, they probably did not start by saying that they needed an Information Resource Manager. More likely, CEOs (Chief Executive Officers), working with their CFOs (Chief Financial Officer), determined that they needed a CIO (Chief Information Officer). At this point, they were describing the **function**, not the actual title. So, just as the CEO is the President, the CFO is the Vice President for Finance, the CIO is the Vice President for Information Resources, or some comparable title. Placed at this level in the organization, the CIO can function as the bridge between top management and the technicians, while applying technology to promote the effectiveness of the organization.

As to the skills of this position, the shift is from the technical to the managerial. Consider this "ad" as a way to convey the flavor of this new "who":

Wanted: Chief Information Officer.
Prerequisite: General management experience and ability to implement the latest technologies.
Technicians need not apply.[8]

WHEN Did This Get Started?

As with most new concepts or types of positions, there is seldom a date marking its advent. But, it is fairly safe to say that IRM and the CIO are less than a decade old.

Through the use of several bibliographic databases, over one hundred references were developed. A review of each reference revealed that this phenomenon really took off in 1979.

In that year, John Diebold wrote about organizations and resources. And, note the title of the article--"IRM: New Directions in Management."[9] Another good indication of the timing and rapid development of this concept was a survey made by the Diebold Group. In that survey of 130 major corporations, it was found that only 5 percent of them had what we now call CIOs in 1979. By 1984, those same companies reported that 33 percent of them had Os.[10]

However, one forward thinking researcher discovered the emergence of a high-level senior information manager as early as 1974. Howard (1974) presented a "communications" model which reflected the information services function in eight universities which had grouped their information functions under such a CIO.[11] Fewer than twenty such CIOs existed in colleges and universities as of 1984 according to Turner (1984).[12] But, by 1986, Fleit (1986) found that fewer than 100 institutions actually had a "czar".[13] But, the fever rises and many CIOs are added each week to reflect a growth that is climbing at an increasing rate.

WHERE Does IRM Fit in the Organization?

There is no generally accepted models for structuring this technological diversity. The technology is too recent in design and too unpredictable in innovation to permit valid forecasts. The present need is to find a balance between centralized management of the entire field through an IRM and creating the proper environment for end-user computing which is neither forcing nor constraining.

Without this ideal model for the location of the IRM function in the organizational structure, most organizations have developed a place at the vice-presidential level or stress that the position of "corporate-wide" in scope and operation. So, expect to see this IRM function in the organizational charts right along the same functional or operational level as marketing, production, finance, administration, and research.

In colleges and universities, clearly the IRM has been moved above the departmental level. Yet, it is not typically at the VP level. To send the right message, the reporting line goes to the Executive VP or Provost level to demonstrate that the function is truly campus-wide.

WHY Do We Need IRMs and CIOs?

There was no watershed event, article, or announcement that indicated **why** we must now have a new, higher-level function in organizations that is called **Information Resource Management**. You know, even that phrase seems awkward. But what ever you call it, the idea was developing that there had to be some name for what is more than DP and bigger in scope than MIS. This new perspective had to embrace hardware from micros to supercomputers, the enhancement of end-user computing, and above all telecommunications. Would it be reasonable to search for that one cause agent to explain the origin of this new function? Well, probably not. Yet, it might be helpful to consider some of the events that certainly contributed to **why** this phenomenon has occurred.

In terms of timing, it could have been the pervasive spread of the micro computer in our society. From a control standpoint, many were concerned that these new personal computer needed to be managed or gosh knows what will happen.

The other major occurrence was the deregulation of the telephone industry. Almost overnight, organizations went from ordering up phones from the downtown office to creating their own in-house telephone companies. And, during this timeframe, data networks and voice-data integration increased in importance.

In higher education, the study by Howard (1974) documented that the reason most frequently mentioned for integrating information services was to lighten the load at the vice-presidential level.[14] When you think about this you realize that the several vice presidents, all with different functions, did not feel comfortable managing an information function also. Other reasons that can be cited for consolidating the IRM function under the CIO include:

--The need for closer coordination of information services.
--The linking or merging because of commonality of functions.
--A means of decreasing "competition" of operations.

CIOs in Research Universities

In 1987, a study was made of the CIOs at the American research universities.[15] About a third of these 91 universities had CIOs. This is a landmark study of CIOs in higher education. There was a slight emphasis on libraries because of the background of the researcher. Yet, a vast majority of the insights developed in the project were right on target for CIOs in higher education.

Some interesting observations came from this work.

--Of the 32 positions identified, 26 different titles were used and none used the CIO title.

--The level of reporting was fairly evenly distributed between President, Executive Vice President, and Chief Academic Officer.

--Over half of the titles were VPs, Associate VP, or Associate Vice Chancellor.

--The most common descriptors used with the titles included: computer/computing, information systems/technology/services/resources, and technology.

--Over 85 percent of the respondents had been in the position three years or less.

--About 40 percent came to the position from other institutions.
--Only 35 percent had majors in computer/physics/engineering areas.
--Over 80 percent attained doctoral degrees.

CIOs in Higher Education

Because of the exhausting variety and size of business and governmental organizations, it was thought that by looking at institutions of higher education a reasonable survey of IRM/CIO could be made. The campuses of America are often referred to as microcosms of society. So, you might be interested to note how this one segment of society is responding to this concept. In some cases, colleges and universities are on the leading edge and sometimes on the trailing. Yet, in the case of IRM and CIO, there is solid evidence that the concept is catching on. This survey only scratches the surface in that CIO positions were the focus. But, these new titles often suggest new organizations and functions.

The hard evidence of what universities are doing with this "computer czar concept" is revealed in a survey of the 3,300 colleges and universities included in the 1987 Higher Education Directory,[16] only 35 have listed such positions. Through other research, 50 more were identified. Positions at the "director" level and lower were excluded. This makes a grand total of only 85 Chief Information Officers or Information Resource Managers in U.S. colleges and universities today. A rather exclusive club!

The Directory uses a new code and description of administrative officers to describe the CIO. The generic title is "Director, Computing and Information Management". The description is "Coordinates computing systems and the flow of information to and from computing operations". In this directory, there is the old title of Director, Computer Center who "directs the institution's major data processing facilities and services".

What's in a Name?

Few if any colleges and universities have followed the lead of corporations by titling the position as Chief Information Officer (CIO). In fact, by looking at the titles of these new officials, it is difficult to know exactly what functions are associated with the office. So, one method of assessing the magnitude of responsibility is to review the "rank" associated with the titles.

The **rank** of these university positions vary widely. Vice President, Vice Provost, or Associate Vice President represent typical "ranks".

Once the rank or level has been appreciated, the rest of the title descriptor can be analyzed. And, here again, there is no standard. Usually, the position is broad in scope. Computer responsibility is usually considered as a given. But, is it to be both **academic computing** and **administrative computing**? Yes, that is normally the case. Including the area of **telecommunications** is common but not universal.

At What Rank?

Following its conservative and methodical approach, universities have not tended to create these new positions at the vice president level. Rather, in trying to be at the cutting edge and hedge their bets at the same time, the majority of these new positions are "ranked" at the "associate" or "assistant" level.

The frequency of the different ranks can be readily seen in **Table 1.**

TABLE 1

CIO Positions Grouped by RANK

30%	Associate Vice President/Chancellor
26%	Vice President
20%	Assistant Vice President/Chancellor
15%	Vice Provost
9%	Associate/Assistant Provost

If the vice president or vice provost rank is used, the individual is clearly a university-wide official. Which implies no special allegiance to academic units or administrative units but rather the concern is for all functional areas of the university. Linking the person to one of the functional areas through an "associate/assistant" title of the principal vice president tends to narrow the scope of the position.

Areas of Responsibility

The scope of responsibility for the "Czar" is also highly dependent on the personality of the institution. And, although the titles following the rank of the position might vary from place to place, there is beginning to emerge a certain uniformity. Note the following summary of **title** data as taken from **Table 2.** Understandably, some of the "titles" were close enough to the major titles that they were grouped with them whenever it appeared reasonable to do so.

TABLE 2

Grouping of Positions by TITLE

35%	Computing & Information Systems
24%	Information Systems
20%	Computing
9%	Computing Services

The translation of some of these words in terms of what they mean in the technology industry may be appropriate here. "Computing (or computer) and Information Systems (or services or technology)" gives the broadest connotation: academic computing, administrative computing, and telecommunications. Normally, when the title "computing" is used, telecommunications is being excluded from the scope of responsibilities.

The personality of each campus dictates if it makes sense to add other responsibilities beyond those just mentioned. For example, the technology of a modern learning resources center suggests that this new Chief of Technology could easily assume such responsibility. Several major universities have moved the libraries under the new Vice President. With similar reasoning, a university press and the various copy centers can fit neatly into this new organizational structure. The responsibilities just described are neither exhaustive nor suggestive. Turf wars can erupt easily over lesser issues.

The purpose of mentioning these different areas of responsibility is to give some notion of the range of activities that might come under this new university vice president.

And, it is interesting that with all of the emphasis in supercomputing, that none of the titles reflect this costly resource. So, that humbles us to recognize that, after all, "a supercomputer is just the fastest computer of the day". Or, the supercomputer of today is tomorrow's mainframe. Thus, one must conclude that there is no need to give the "czar" such a narrow title.

Organizing at Florida State

Now, let us move from the general to the specific or from theory to the way we "practice" the management of technology at Florida State University (FSU). In the late 1970s, after several attempts to fill the vacant computing center director's from in-house or local sources, a national search was conducted. As those of you have been a part of such searches, finding these talented computing managers is no easy task. In fact, after several unsuccessful searches, the University Executive Council went back to the drawing board. Enough time had passed that both the technology and the structure to manage it was beginning to change. And, the fact that the University would have to manage its own telecommunications (because of deregulation), made the Council take a whole new look at the position.

In the Spring of 1984, it was decided that the position of Associate Vice President Computer and Information Resources should be established and filled as soon as possible. This new office would be responsible for **academic computing, administrative information systems, and telecommunications.**

Further, it was decided that the position would be a university-wide official reporting to the Chairman of the Executive Council, who is also the Provost. Please take note that three key management and organization decisions were made consciously at this point.

1. The major technology areas--academic computing, administrative computing, and telecommunications--that affect campus end users were included in the scope of responsibility;
2. The new associate VP was to operate as a university-wide official; and
3. The position was placed at the vice-presidential tier of the organization by "drawing" the reporting line to the Provost.

Closing Thoughts

Do you ever get the feeling that, somewhere along the way, the computer industry has been tripping over itself in the race toward the automation of America by falling short of its own ambitious goals? The computer revolution was supposed to liberate workers from mindless drudgery, yielding soaring increases in productivity, automate the office and home alike, and uplift the lot of virtually every soul. And, it has done some of this. But even the industry's most enthusiastic visionaries now admit it will take decades, perhaps well into the next century to truly fulfill such vaunted promise.[17]

Much has be explained and observed concerning IRM and CIOs. But, new concepts and new positions, a better world do not make. But really, managing information resources in the 1990s should be a lot easier than today. By then, management will have recognized the importance of information as a resource and will have become involved in its management.[18]

But, in the meantime, I wish you well back at your campus. Be of good cheer. Be good managers, take care of your people, and be flexible in the application of these new technologies. And, before you know it, we'll all be enjoying the 21st Century.

FOOTNOTES

[1] Alvin Toffler, *The Third Wave* (New York: William Marrow & Co., Inc., 1980), pp. 5-14.

[2] John Diebold, "IRM: New Directions in Management," *Infosystems*, October 1979, p. 41.

[3] Allen N. Smith and Donald B. Medley, *Information Resource Management* (Cincinnati, OH: South-Western Publishing Co., 1987), p. 72.

[4] Milton Bryce, "The IRM Idea," *Datamation*, April 15, 1987, pp. 89-92.

[5] William R. Synnott and William H. Gruber, *Information Resource Management: Opportunities and Strategies for the 1980s* (New York: John Wiley & Sons, 1981), p. 4.

[6] Anne Woodsworth, "The Roles and Responsibilities of the Senior Information Manager at Selected American Universities," Final Report to the Council on Library Resources, Washington, DC, October 1986, pp. 35-37.

[7] Synnott and Gruber, p. 66.

[8] John Rymer, "Chief Information Officer," *Computer Decisions*, September 1983, p. 9.

[9] Diebold, *loc. cit*.

[10] John Diebold, "The Chief Information Officer Concept." A Preliminary Report of the Diebold Research Group, December 1984.

[11] H. A. Howard, *Administrative Integration of Information Resources and Services in Universities in Canada and the United States: A Report to the Council on Library Resources*, Washington, DC, 1974, p. 24.

[12] J. A. Turner, "As Use of Computers Sweeps Campuses, Colleges Vie for 'Czars' to Manage Them," *Chronicle of Higher Education*, *28* (14), 1984, pp. 1, 14.

[13] Linda H. Fleit, "Campus Computing Czars: The Issues." *Edutech Report*, April 1986, pp. 4-6.

[14] Howard, *loc. cit*.

[15] Woodsworth.

[16] Constance H. Torregrosa (ed.), *1987 Higher Education Directory* (Falls Church, VA: Higher Education Publications, Inc., 1987).

[17] Dennis Kneale, "The Unfinished Revolution," *Wall Street Journal*, September 16, 1985, p. 8.

[18] Paul Tom, *Managing Information as a Corporate Resource* (Glenview, IL: Scott, Foresman & Co., 1987), p. 307.

Administrative Distributed Computing can work

Stephen Patrick

Abstract

Much discussion has taken place in the trade journals about the concepts of distributed computing, while in practice distributed computing is a rare phenomenon. The University of Wisconsin-Stevens Point (UWSP) moved from a centralized (mainframe) DP shop to a distributed environment (mainframeless) with applications processed on one of seven UNIX computers and a host of micro computers.

Key differences between the UWSP approach and other distributed computing approaches are that UWSP operates in a multi-vendor environment, does not maintain a central mainframe, and computer users manage the resources without a central data processing organization. Determinate factors for the success of distributed computing are social, political and economic, not technical.

Administrative Distributed Computing can work

Stephen Patrick

Introduction

For the past, five years the University of Wisconsin-Stevens Point (UWSP) has been moving to distributed computing. The UWSP approach is quite different from traditional distributed computing. We have eliminated the central computing organization distributing nearly all computing resources to operational departments. The users of computer applications are in control of all aspects of their systems. We call this version of distributed computing "User Driven Computing". The shift to user driven computing was difficult, and at times painful, but it resulted in better applications with line managers taking responsibility for their computing needs.

The UWSP mainframe environment.

In 1983, UWSP performed most of its computing on a Burroughs B6930 mainframe computer. Administrative computing was mainly batch oriented. UWSP was beginning to get into on-line programming, but the resources needed for on-line systems were not present. The B6930 had 110 Burroughs compatible terminals on its network with 36 dedicated to Academic computing and the remainder to Administrative computing. Unfortunately, when more than 45 terminal users were active at any time the response time degraded to an unacceptable level. Academic computing requirements vary considerably with no load at some periods and a full load at other times. When academic Computing was loaded, there were only 9 terminal sessions available for Administrative computing.

The computing organization in 1983 was a typical "Centralized" data processing organization. The Executive Director of Computing reported to the Assistant to the Chancellor. Three units reported to the Executive Director - Academic Computing, Computer Operations, and Systems Development.

The move to distributed computing.

The reason why.

Listed below were the perceived problems with the UWSP mainframe environment.

The unit was not responsive to users needs.

Computing was very expensive.

A move to on-line computing would require a massive capital investment.

Academic computing needs were not well served on a Burroughs mainframe.

The unit was very bureaucratic.

Certain users were treated better than others.

The Executive Director promised on-line inquiry of the data base, but did not deliver.

The department continually went over budget.

Programmers and Scheduling personnel were surly.

The Burroughs mainframe was not "state of the art" hardware.

Cobol was not "state of the art" for program development.

In 1982, the Controller wanted to implement a computer system to support Purchasing, Accounts Payable, and Stores Inventory. The Burroughs mainframe did not have sufficient capacity to do this and a project was initiated to do this in a distributed environment. A programmer from Computing was assigned to the Controllers office for one year to implement this project. The project was very successful. Computer resources were under direct control of the Controller. Response time was better than it was for mainframe applications. The distributed system cost less on a per user basis than mainframe applications.

Organizational changes made.

The fateful day for computing at UWSP was November 14, 1983 which was known locally as the "Holiday Inn massacre". A radical approach was taken. Rather than firing the Director and replacing him, computing was split. Academic Computing was placed in Academic Affairs and Administrative Computing was placed in Business Affairs. Within Business Affairs, Administrative Computing was further divided. Computer Operations was placed in Financial Operations and Systems Development was renamed Administrative Systems and placed in General Services. Business Affairs management felt that the problem with computing could best be solved by making the unit managers responsible for their computing applications. A strong push toward distributed computing was initiated early in 1984 and continues to this day.

From 1984, resources from Computing Operations and Administrative Systems were reallocated to Academic Computing and user areas. In 1986, $150,000 base budget was returned to the campus general budget. Computer Operations will meet its final demise on July 1, 1988. Administrative Systems remains, but its mission has changed. Administrative Systems is responsible for providing the campus wide network, the Computer Information Center, and a very limited application development role (1 full time programmer/analyst after July 1, 1988).

The UWSP distributed environment.

Technical environment.

Early in the movement to distributed computing, Business Affairs management attempted to develop concepts needed for successful distributed computing. The concepts we developed are listed below:

Software First

The purpose of computing is to run applications. Software makes up applications, not hardware. The primary factor in selecting computers at UWSP is the software requirements of the application. We will select software, then purchase the appropriate hardware to run the software.

Vendor Independent Environment

For years, we have been at the mercy of a single vendor (Burroughs). We felt that we wanted to be in the driver's seat in vendor negotiation. For that reason, we sought a vendor independent environment.

Fourth Generation Programming

The development and maintenance of Cobol based computer software is a greater effort than an institution our size can afford. Cobol based applications are slow to develop and difficult to maintain.

Campus Wide Computer Network

Distributed computing implies that a large number of computers will have to share data. If they are to share data they must be able to communicate with each other. Additionally, end users will need access to applications on a variety of computers. This objective was attained in 1985 when we installed an AT&T PBX and campus wide network.

In 1984, Business Affairs issued an RFP for sufficient computing to handle all Business Affairs applications. This process was our attempt to establish distributed computing standards consistent with the concepts stated above. As a result of this process, we purchased four Sperry computers establishing the following standards:

UNIX Operating System

Numerous computer vendors are marketing computers with a UNIX operating system. Properly implemented applications should be transportable from one vendor's hardware to another. This makes price a marketing factor which computer vendors dislike, but provides very cost effective computing. An alternative to UNIX is MS-DOS for personal computer applications.

Oracle Data Base

Oracle is a data base management system that contains the tools necessary to do all the programming for simple applications and 80-90% of the programming for complex applications. Oracle also helps to support vendor independence because it is supported in an IBM, DEC Vax, and UNIX environment.

The proof of UNIX as a vendor independent environment came to us last year when we issued an RFP for a large mini computer for student records. Three major computing vendors with UNIX computers were locked in a price war. We obtained a HP 9000/850 at a cost significantly less than the cost of a comparable computer with a proprietary operating system.

At this time, we have a many UNIX computers performing different applications in a distributed environment.

Sperry 5000/90 - Accounting

Sperry 5000/80 - A/R, Cash receipts

Sperry 5000/40 - Physical Plant

Sperry 5000/40 - Capital Inventory, Backup

HP 9000/850 - Student Records (Summer 88)

AT&T 3B2 - Alumni

AT&T 3B2 - Electronic Mail

Economic factors.

When we began the move to distributed computing we were faced with a mainframe computer at its performance limit. To upgrade to a computer that would be able to handle 100 users would have cost in excess of $1,000,000 or more than $10,000 per user. Our distributed pilot project (1982) resulted in a 12 user system for $65,000 or $5,500 per user. Costs have changed considerably since that time, but the proportions have not changed. Economy of scale does not apply to computing. It costs more on a per user basis to buy a mainframe than a mini or micro computer.

Resources on a smaller computer can be obtained in smaller increments. It is much easier to obtain funding to upgrade a $65,000 mini computer than a $1,000,000 mainframe computer. This was a factor at UWSP. We had the funding to purchase small computers, but did not have the resources to upgrade to the next mainframe model in the Burroughs line. Field upgrades to increase the memory, disk, or data communications capabilities are six digit investments on a mainframe.

By connecting the cost of computing to the applications, we are in a position to do accurate cost/benefit analysis of computer applications. With a single multi-purpose mainframe it is nearly impossible to find out accurate costs of a proposed application. It is much simpler to predict and measure costs when all hardware and software needed by the application are dedicated to the application.

Social environment.

When the Business Affairs unit discovered the benefits of distributed computing, the rest of the campus was converted to distributed computing the same way Cortez converted the Aztecs to Christianity. The (implied) threat was that at a certain date the Burroughs mainframe would be sold and if you didn't have your own computer it was too bad. This is not a way to win friends, but with strong political support and the guts to maintain the pressure, it is a way to implement user driven computing. I do not feel that there is another way to accomplish this. Eventually, operational departments came to realize that they would have to accept distributed computing.

What was once a central organization was disbursed to the user areas. Each major unit hired individuals to function as systems analysts, programmers, and computer operators. Users were in complete control of their resources. They had the staff to make the systems do what they wanted. This was very successful at meeting the needs of the offices. Programmers worked in user areas, developed a rapport with their clients, saw problems first hand, and had to live with the results of their efforts. The level of distribution of resources is not consistent across campus. Some areas concentrate their computing resources at a higher level than others. Admissions, Financial Aids and Registration have decided to share a computer. This decision is a management decision of each individual unit.

We did experience some negative results to the move of computer individuals to operating units. Each programmer became a generalist with no "experts" in technical fields (data base management, systems analysis, etc). Standards were difficult to develop and monitor. It is difficult to concentrate resources for major projects. Resource allocation is based on a department having the budget to accomplish its goals, not necessarily the needs of the unit. No backup of technical individuals (things go wrong when the one person that can correct a problem is on vacation). Small departments who cannot justify a full time programmer have a difficult time with computing. Operating departments must be concerned with all the problems of computer operations like backup and recovery, scheduling, resource allocation, and system administration. Certain equipment is cost effective when centralized, but not cost effective when distributed. Each department cannot purchase decollators, bursters, high speed printers, or 9 track tape drives. This often makes pre and post processing more difficult than it was in a centralized environment.

We did not concern ourselves with the problems of distributed computing until they occurred. UWSP management felt that we could solve any problems as they occurred. We continue to resolve these problems.

What it takes to make distributed computing work.

It is not my intent to say that our method of distributed computing will work in all environments, or even in a majority of environments. Certain characteristics have to be present for user driven computing to work, and actions must be taken to insure that user driven computing continues to work.

Distributed management style.

Our university has a highly distributed management style. The centralized computing utility was the exception rather than the rule. If middle managers are not allowed to make decisions, there is no point to user driven computing.

Talented "risk taking" managers.

Managers are required to take the initiative and go into unfamiliar areas. The unit manager must become somewhat of a computer expert. Some managers welcome this challenge and become very effective computer managers. Other managers have not adapted well to this change. These managers need someone else to solve their computer problems and units with a significant number of these types of managers should consider centralized computing.

Communication between managers.

In a central DP environment, much of the application integration is hidden from operational managers. In a distributed environment, all integration needs to be explicitly identified and communication weaknesses are brought to the fore front. It needs to be clearly defined what functions take place in what applications.

Hardware and software standards.

Ideally, individuals would execute applications and would not need to know what computer is the host for the application. Consistency should be maintained between applications. The same user interface should be used on all systems. Screens should be designed in a consistent manner. These factors should be present in any organization, but they are more difficult in a distributed environment because each programmer has a tendency to do what he sees without consideration for the "big picture".

Hardware and environmental software compatibility standards need to be implemented. It would be difficult for the end user to use a different terminal emulator for each application.

With distributed computing programmers and operations personnel are stretched fairly thin. The closer hardware, software and procedures conform to a standard, the easier it is to go outside a unit for help or coverage when critical individuals are not present.

Computer communication network.

A campus wide network is very important in a distributed environment. Our network allows any computer user on campus with a telephone to communicate with any computer on campus. In addition, massive amounts of data must be passed from system to system. With the current state of the art, the most feasible way to do this is through batch file transfers. In the near future, applications will be able to use and update data in data bases on different systems. A high speed network is essential for this to take place. Because we have a campus wide network, we will only be dealing with software modifications to implement distributed data bases.

Communication - the key factor

Most of the problems with distributed computing result from a lack of communications between the individuals involved. Several groups of individuals need to meet regularly to keep computing on an even keel.

Line managers of computing resources need to establish application responsibilities and need to be concerned with the presentation of the systems to end users. A suitable vehicle for this would be a coordinating committee. At UWSP, this committee consists of four faculty members and five administrators. The group contains both line managers and technically oriented individuals. This committee is an advisory committee and has functioned informally for a number of years. Now that many of our distributed systems are on-line and we have experience in this environment, the campus has formalized the committee.

Technical individuals need to communicate to exchange ideas and standards. There needs to be a forum for programmers to learn and express their views. Professional development of technical personnel needs to be a concern. Operational managers are often not aware of the need for computer professionals to continue to grow. One approach to this situation would be to have a regular technical seminar where all the computer professionals gather and show what they are doing.

User driven computing has succeeded at UWSP, although not without a certain amount of suffering. Certain activities continue to be centralized. The campus network is a university wide resource. The Computer Information Center is a "one stop" resource for campus end users to deal with the complexities of the situation. Data integrity and consistency is a function of the Computer Coordinating Committee. Some of our areas have had tremendous successes in computing, while others have limped along. The success of a unit is directly attributable to the manager of that unit.

User Support for Evolving Technologies in Higher Education

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Abstract

Effective support for end users of computers has been an important issue in higher education from the first applications of general purpose mainframe computers through minicomputers, microcomputers and supercomputers. With the continued growth of end user computing in an environment of changing technologies, administrative and academic computing organizations must organize to meet the specific needs of their institutions. This paper reviews the development of end user support and examines a number of organizational models which can be useful in supporting end user computing.

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I. Evolution of End User Computing Support

User support may be defined as providing the information and assistance which enables people to use computers as an effective tool to accomplish work. These end users are the faculty, administrators, and students involved in the research, instruction, and administrative activities of our colleges and universities. To understand how evolving technologies will impact end user needs and our support organizations, it is useful to look at the history of end user computing and support.

The automobile analogy

The development of end-user computing is, in many ways, analogous to the development of the automobile in the first half of the 20th century. The initial owners of automobiles were forced, both by the early technology and a very limited "support organization", to know a great deal about the technology and its application. The mass production of automobiles both resulted from and encouraged the development of support organizations: "full service" gasoline stations, restaurants, motels, and organizations such as the American Automobile Association.

The automobile has had a significant impact on society. The movement of homes and businesses away from central cities and the development of the interstate highway system are significant examples of the universal adoption of technology and the importance of an adequate support structure to that evolution. Although computing is a much newer technology than the automobile, it is already clear that a combination of technology-driven advances and effective end-user support structures will be required if computing is to realize its full impact. It is difficult to imagine that the automobile would have achieved universal acceptance if all drivers were required to be able to repair their cars or even crank them by hand!

Evolution of End User Computing in Colleges and Universities

Like the earliest automobiles, the first university mainframe computers were limited in capabilities, accessibility, and usability by other than highly trained people (see Figure 1). Toward the late 1960's, end users were scientists and their "end user computing tools" were FORTRAN compilers and collections of subroutines. To use these tools, researchers had to go to the computer, submit programs, and wait for results. Administrative data processing was performed by professional programmers. The end user had little or no direct involvement with the computer.

Figure 1. Mainframe End User Computing in Higher Education

	1960		1970		1980	
What	Engineering Scientific research	Accounting, Admin, Computer science	On-line data entry, Statistics	DB Query, Ad hoc reports	Report Generation, "What If", Dept data mgt	E-mail, Ad hoc query, Biblio mgt File transfer
End Users	Engineers, Scientists, Grad students	Scientists, Prof admin programmers	Social scientists, Students	"DP Coord", Admin staff	Functional admin users	Info managers, Non-numer research
Support	Prof programmers Part-time consultants	Grad students, full time consultants	Colleagues	Prof support staff	Info Centers	Dept support staff
Hardware Software	Primitive ass'y language	FORTRAN and other compiled languages	Interactive processing, parameter driven stat pkgs	Full-screen interactive Info retrieval, DBMS	Admin tools (ADRS) rel DBMS languages	Fourth generation
Access	on site, limited access, run your own program	on site job submission	Remote terminals, convenient access	Inexpensive ASCII terminals	Higher National speed comm links	networks

To assist these early scientific end user computing efforts, the professional staff at first provided rather limited programming assistance. The demand for computing services increased as wider segments of the academic community recognized the advantages of the new technology. Academic computing centers began to employ "user consultants", often graduate students, to provide advice, assistance, training workshops, and documentation.

With speed, storage, and software improvements, interactive time sharing became a reality in the 1970's. Computing was accessible from one's own office, providing a (relatively) quick response. In the administrative area, these developments supported "on-line" query and data entry; for researchers, remote job entry meant fewer trips to the computer. Ease of use was still a problem — a great deal of training and assistance was still required. Support organizations had to adapt their delivery systems to provide timely assistance to a dispersed population.

To reduce the need to learn programming, groups of social scientists and statisticians at several universities developed parameter-driven statistical software. Using these packages, an end user could perform complex statistical analyses without knowing a programming language. Large numbers of social scientists began to use computing in their research and instruction. For administrative data processing applications, end user computing began in earnest with non-procedural reporting packages. To allow end users to make use of these software tools, support staff were called upon to provide training and assistance in the software, the structure of data files and the computer system's control language.

In the early 1980's, the ability to perform sophisticated data analyses without extensive programming skills stimulated computer use by large numbers of inexperienced faculty, students and administrators. For the first time, the user support staff found it necessary to provide assistance and documentation to a growing number of individuals who were not interested in or willing to learn the details of computer operations (job control, data storage, etc). In some cases this new class of users was assisted by the academic user support staff. In other cases, administrative centers developed their own end user support using IBM's Information Center model.

IBM-Canada first used the term "Information Centre" in 1976 to identify the organization which provided support for non-programmers. These end users employed tools such as "A Department Reporting System" (ADRS) and the forerunners of today's 4th generation languages to create reports and even develop small applications.

The development of minicomputers in the late 1960's and early 1970's followed a similar end user evolution pattern. Early minicomputers met specific research needs for real-time data acquisition with readily available hardware. Simplicity kept down the cost of hardware, software, and support.

As research applications grew, the systems' users often developed related management applications such as data analysis and equipment inventories. These applications were often supported by a scientist who had assumed the role of "system administrator" — handling everything from installation and maintenance of software and hardware to assisting others in developing application programs.

Figure 2. Minicomputer End User Computing

	1970		1980	
What	Process ctrl, real time data acquisition	Research project admin.	Vertical market admin systems, "What if," ad hoc repts	Ad Hoc Query electronic mail, file transfer
EndUsers	Quantitative researchers, students	Admin. support staff	Financial and office admin users	Information managers, non-numer researchers
Support	Colleagues	"System Administrators"	MIS, Dept support staff, third party	Information Centers
Hardware Software	Real time data acquis peripherals	Full-screen interactive	Admin appl, info retrieval DBMS	Fourth generation languages, relational DBMS
Access	on site, dedicated, run your own pgms	Access from department offices, high speed	Higher speed communic links	National networks

The growth of management applications created a demand at the department level for business-oriented software tools, such as data base management software. Vendors initially attempted to market minicomputers to departments as general purpose computers, but were unsuccessful because they found support staff both necessary and non-existent. Consequently, a number of third-party organizations developed and supported industry-specific applications systems for minicomputers. Office automation systems are a common example.

Nevertheless, the scope and complexity of administrative minicomputer systems continued to increase, and along with it, the need for support staff. In academic laboratories, it was often sufficient for the technical staff to be provided with manuals and advice from more experienced users. In administrative departments however, functional managers quickly found themselves overwhelmed by the effort required to use the new technology. As noted above, third-party organizations were often used to meet this need; in other cases, an "MIS department" was created or assigned to undertake this responsibility. Continuing development of software "packages" led to less dependence upon traditional MIS software development support. With the shift in emphasis to consulting, Information Centers often assumed the responsibility for minicomputer support.

Figure 3. Microcomputer End User Computing

	1975	1980	1985
What	Research, Mech control	Vertical market admin systems. OA, query, ad hoc repts	Ad Hoc Query, Electronic mail, biblio data bases
Who are new end users?	Engineers, computer scientists, hobbyists	Financial and office admin users	Information managers, Non-numerical researchers
Support added	Colleagues	Colleagues, 3rd party, and limited prof. staff	Info Centers and Departmental support staff
Hardware & Software Development	Full-screen interactive, ass'y language	Admin appl., Spreadsheets DBMS, Acctng	4GL, Networks
Access to services	on site, dedicated access, run your own pgms, cost OK for indiv	Mainframe terminal emulation	Software and info. via dept. LANs and low cost

Following the same end user development path (Figure 3) as mainframe and minicomputers, the first generation of microcomputers were the play things of hobbyists and useful tools for a knowledgeable few. The machines lacked a user interface, but they did have convenient access, computing power, local storage, and quick response time—and they didn't cost much.

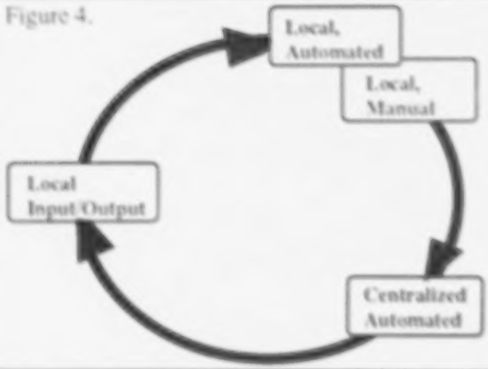
With the Apple II and the development of Visicalc, the first general purpose end user software, the personal computer moved quickly to became a tool for financial and administrative users. Although beset with "user hostile" problems like complex operating systems, low cost and menu driven applications made computing very accessible. IBM's entry into the microcomputer market created new respectability and credibility — and a flurry of new software applications and users resulted.

End user support needs proliferated as well. Support organizations were called upon to supply the same training, troubleshooting, and data access support for microcomputers that end users had come to expect — however, this technology introduced larger numbers of inexperienced users. The existence of support organizations has led to an even faster rate of adoption than had occurred for mainframe or minicomputers.

End User Computing Today

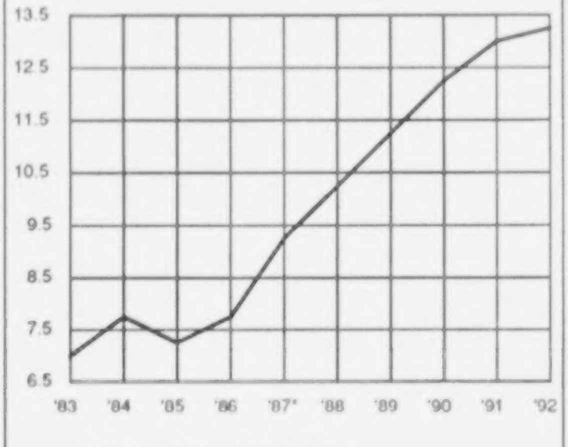
As indicated in Figure 4, this evolutionary process has brought us full circle. Information processing is once again the responsibility of local operating departments. On an institutional scale, we now find ourselves with a wide range of popular hardware and software tools for

Figure 4.



end user computing, connected by national networks, and a sometimes wider variety of end users. It has been predicted that at the current rate of growth, especially for personal computers, (Figure 5), end user computing will likely be 90% of all computing by 1990 (Wall Street Journal, 1987).

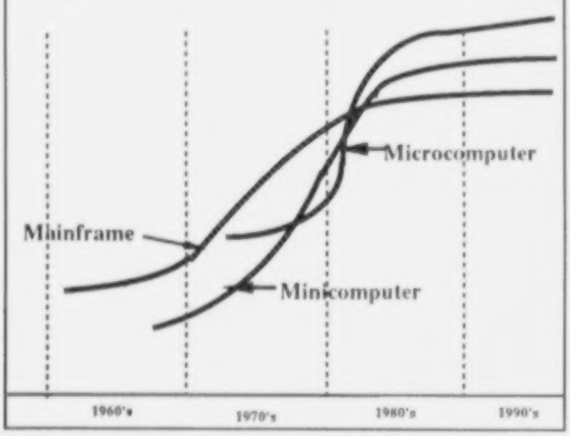
Figure 5. Annual Sales of Personal Computers in the U.S. in millions.



*Sales in 1987-1992 are projected

Concurrently, the time needed for mainstream adoption of each new technology has been decreasing; from 25 years for the mainframe to roughly 10 years for microcomputing, (Figure 6). The change in the rate of acceptance is due largely to two factors: access and support. Access, as we have seen is a function of cost and convenience. Support has been provided by, or evolved from, organizations which provided support for preceding technologies.

Figure 6. Adoption of New Computer Technologies



Issues Facing End User Computing Support

Today, we face three major challenges in supporting end user computing:

1. How best to support maturing technologies
2. How to manage the impact of decreasing hardware costs
3. How to apply and adapt support strategies to new technologies

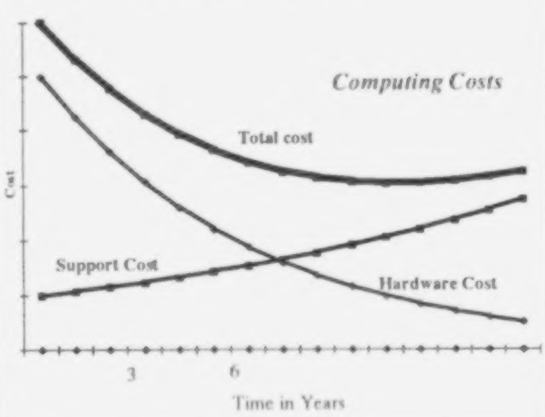
As end user computing continues to evolve, questions arise about how to best support this maturing technology. Two trends are likely to continue:

1. The evolution from technically sophisticated users towards application—oriented users who view the computer system as a "tool"
2. The rapidly increasing capabilities of the computer software, hardware, and communications networks

If our goal is to make end user computing effective (which is not necessarily the same as efficient use of hardware) then the combined effect of these two trends will be to increase the need for, but perhaps to change the focus and delivery, of user support. For example, fourth generation languages allow information to be organized according to a "relational" model. Because a user needs to know less about database structure than with previous tools, less support will be needed there, but more support will be needed for training, for evaluation of new tools and techniques, and for communicating the information across campus. In addition, there will continue to be a need for support services such as file conversion, networking, access to data, development of macros and templates, coordination of purchases and repairs, and strategies for coordinated planning.

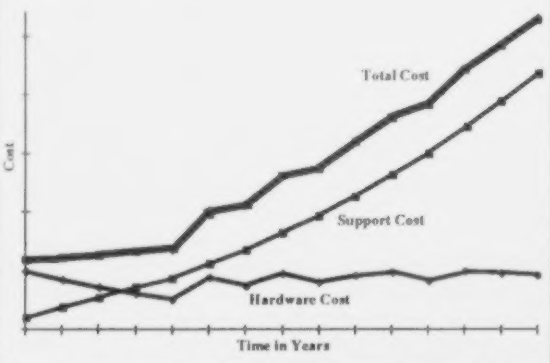
The second challenge we face is the impact of the rapidly declining unit cost of computing equipment coupled with the increasing cost of people and software development. This fact has been widely recognized by James Emery (Emery, 1978) and others. Figure 7 shows these annual cost curve expectations. In the late 1970's and early 1980's, it was expected that the decline in equipment cost would offset the increase in the cost of people and software so that substantial increases in the amount of computing could be accomplished within a relatively constant budget (in real dollars). Many academic institutions, emerging from a decade of intense cost pressures resulting from inflation, expected to be able to meet the needs of faculty, administrators, and students for the benefits of computing technology without significant increases in funding.

Figure 7. Predicted Computing Costs



This has not, however, been the case. As shown in Figure 8, declining hardware unit costs have lead to increased purchases and therefore a relatively flat curve for total hardware cost rather than the predicted declining one. The increase in number of units purchased has lead to an increased demand for support and therefore an increased total cost. This effect is easily seen in the impact of the relatively low price of Apple and IBM personal computers which resulted in a rapid increase in the rate of purchase (Figure 5), more than offsetting the decreased unit cost. In addition, this created an increase in the demand for software, user support staff, and maintenance services. Many organizations continue to struggle with unexpected growth in the overall cost of computing resources along with difficulties in managing the acquisition and support of a large volume of distributed equipment and software and training or recruiting support staff.

Figure 8. Actual Costs



Our third challenge is how to support new technologies. As the "old" technology matures, new technologies are evolving. Supercomputing with its associated national networks is certainly one of these. With supercomputing we are seeing a repeat of the same adoption cycle that we have seen for mainframes, minis, and micros. The National Science Foundation program for supercomputing has recently recognized the importance of user support to speed the evolution from specialized resource to widespread adoption — to further compress the adoption curves shown in Figure 6.

Another new technology beginning to impact instruction is the evolution of visual learning environments such as MIT's Project Athena. Graphics rich computers provide developers with new software possibilities — and new areas to support. Manipulation of graphic information requires intensive computational capabilities, large memories, high speed network access to data bases, and shared specialized resources.

The challenge facing end user support organizations is to apply and adapt the knowledge and skills learned in supporting the "microcomputer revolution" to these new and evolving technologies.

II. Support Strategies

Is a Formal Support Structure Necessary?

In designing a strategy to meet these challenges, one of the first questions that must be asked is whether a formal support structure is necessary at all. A major argument for providing formal support for end user computing is to insure that end users can focus on their jobs, not on using the computer. As we have seen in the evolution of each of these technologies, initial support is provided by the familiar department computing "guru"— the professor (or accountant, or ...) who started colleagues computing and who now finds herself or himself occupied for large amounts of time answering questions, troubleshooting, and sometimes changing printer ribbons. The fact that this phenomenon exists and has existed for each technology is proof that support is both necessary and inevitable, whether in a form that is in the best interests of the institution or not.

A second reason for formal structure is that without, it is virtually impossible to evaluate the efficiency or effectiveness of support.

A third reason is to facilitate access to distributed information. Effective use and understanding of data by end users, who are not the data "owners," requires coordination such that data is defined, access is controlled, if necessary, and quality and timeliness are assured. Given that most end users use data from a variety of sources, a formal structure for providing access is necessary.

Goals of End User Support

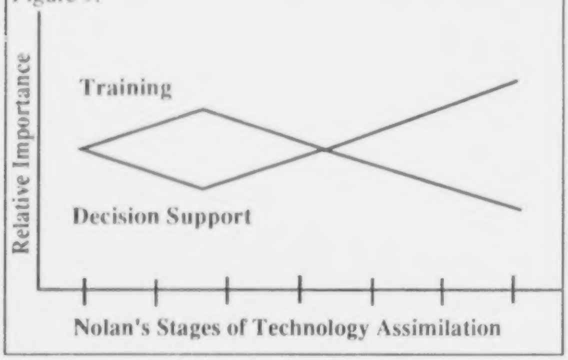
Before defining a formal structure, it is important to review the goals for end user support. These goals reflect the dynamic state of technological change in institutions. They include:

- To achieve the institutional mission
- To recognize that technologies for a given institution evolve at different points in time; for example, an organization may have mature technologies as well as those that are just being initiated.
- To empower the end user (whether an individual or a department) with the ability to pursue his/her own information technology requirements.

With these goals in place, an institution can pursue an organizational structure for end user computing support which best meets its needs.

The evolution of technologies (as depicted in goal #2) seems to move through different phases. One example of the phases necessary to support a technology is shown in the following chart (Figure 9) by Burkin (Burkin, 1985). As technologies evolve in an institution, so must the support of these activities change.

Figure 9.



In the next section, we take the concept of evolutionary phases a step further by examining Nolan's model of the stages theory of computer growth.

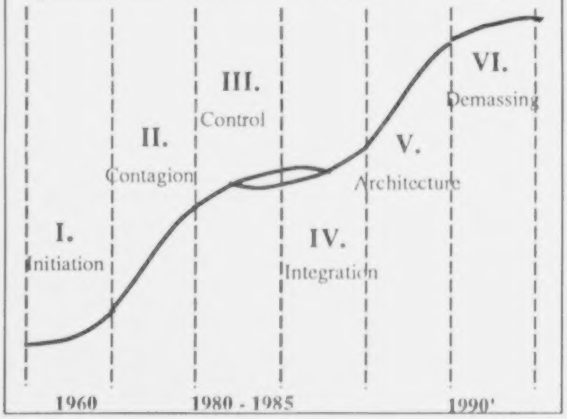
Nolan Model — A Theoretical Framework for Support

Richard Nolan first developed the stages theory of computer growth in 1973. As shown in Figure 10, Nolan's stages theory is based on identification of an S-shaped learning curve of technological assimilation. "The learning curve, manifested by a company's annual expenditures on computer technology, proposes to reflect the company's organizational learning of how to incorporate computer technology to carry out business functions more effectively and efficiently." (Nolan, 1984)

In 1979, Nolan expanded the original four stages to six. The two additional stages reflect computing in the maturing organization. As noted in Figure 10, the six stages are initiation, contagion, control, integration, architecture, and demassing. Stage one is the introduction of new technology and raising awareness and interest to stage two where everyone wants to get involved. In the third stage, the institution tries to bring some order to the chaos through control. Technologies are integrated in stage four. The last two stages reflect the maturing organization. These stages appear simultaneously for different areas of the institution because of the many and varied user-oriented technologies. "During the early 1980's it became clear that computer expenditures were accelerating and growth was being driven not by DP technology but by user-oriented computer technologies." (Nolan, 1984)

Figure 10. Nolan's Stages of Computer Growth

Organizational Models: Descriptions and Analyses



Having considered the need for a formal structure, the goals of end user support, and the Nolan model for the adoption of technologies, we will now examine several organizational models which may be useful in establishing a support structure. Since the mission, tradition and needs of end user computing support will vary from institution to institution and over time, we will describe and compare four distinct models:

- End user support — centralized within MIS
- End user support — centralized and separate from MIS
- Information Resource Center
- Function/discipline-oriented end user support

Any one of the four models presented may work effectively in institution "A" and be completely ineffective for institution "B." The overall organizational structure of the institution, the manner in which computing evolved on the campus, and the "mentor" of end user computing play critical roles in how end user computing is supported. (Atre, 1986). In addition, the success of any model supporting end user computing is dependent on the development of a "strategic direction" for the implementation of new technology by the institution. (Gerrity and Rockart, 1986, p. 30).

In Figure 11, a summary comparing the four models across several key factors is presented. Additional detail for each model is found in later sections.

Advantages:
- easy access to systems support personnel
- global perspective on the direction of computing

Disadvantages:
- limited user influence on design, procedures, and services - end user support is the creation of the central IS department
- limited staff with multiple products and services to support
- interrupt-driven support severely impacts development and maintenance activities

Figure 11. Organizational Models

Key Factors	END USER COMPUTING IN MIS	END USER COMPUTING NOT IN MIS	INFORMATION RESOURCE CENTER	FUNCTION/ DISCIPLINE ORIENTED
Scope	Institution	Institution	Institution	Department
Staff Priority	1. Tools/Tech 2. People	1. People 2. Tools/Tech	All Information Tech Skills	Application Oriented
Activities	Write Programs	Acquire and Use Programs	Coordination and Planning	Acquire and Use Programs
Objectives	Efficient Use of Computing Resource	Effective Use of Computing Resource	Global Optimization	Local Optimization
Advantage(s)	Access to Systems Support	Flexibility in Meeting User Needs	Effective long-Range Planning	Understands Functional Area Needs
	Global Systems Perspective	Relief from DP Stereotype	Reduced Service Duplication	User Sets Priorities
Disadvantage(s)	Limited User Input in Type of Service Interrupt-Driven Versus Development	Limited Access to Systems Support Reduced Global Systems Perspective	Long Queues for Service Delivery Overlap of Operational Activities	High Risk Personnel Investment, Lack of Quality Control

End User Support — Centralized within MIS

Centralized end user support evolved from the traditional data processing organizational structure. When the end user needed changes to a report or enhancements to a system, a request was made to the centralized data processing function. IBM created a new twist in this trend with the formation of the "Information Center" concept. The Information Center was designed as a centralized end user support organization that would provide training, help resolve problems, and provide access to new "tools" with which end users could quench their thirst for data and information by themselves. End user support organizations (like the "information center" concept) developed quickly within the MIS umbrella to assist with the proliferation of personal computers in the early to mid 1980's. End user support organizations under MIS may report to the Director of MIS, the application development manager, or even the data base administrator.

End User Support — Centralized and Separate from MIS

In some institutions of higher education, end user computing support reports directly to the Office of Institutional Research or the Provost. The development of end user computing support originated in a functional area instead of data processing. Many of the same functions are performed in this structure like those found in a centralized, MIS managed group. However, the mission may not be the same and may create solutions and problems different from the first model presented.

Advantages:
- greater flexibility in meeting user needs — less structure
- relief from traditional DP stereotype
- possibly greater knowledge of functional areas

Disadvantages:
- lack of access to systems support personnel

- possibly limited involvement in setting strategic direction and understanding of global concerns

Information Resource Center

The Information Resource Center is an integration of organizations often coming from different "cultures" in the institution, to provide institution-wide guidance, direction, and cooperation in the use of technology. The Information Resource is "the set of procedures, users, software, hardware, data, and human resources that work together to provide necessary information to a firm." (Licker, 1987) This center may report to the Chief Information Officer (CIO) and may comprise MIS, the computing center(s), audio visual services, the library, institutional research, telecommunications, among others. Coordinated planning for information technology has been the force driving consolidation of some or all of these information-based service agencies.

Advantages:
- more effective long range planning and coordination of technology and its application
- reduction in duplication of services

Disadvantages:
- overlap and confusion with operational activities
- differing missions, employee pay scales, and classifications
- introduction of long queues for service delivery

Function/Discipline—Oriented End User Support

This fourth model applies the technology trend of distributive processing to organizational support structures. Specialized computing needs in functional areas, combined with an increased need to strengthen the business orientation of information systems, creates a need for functional end user support. In general, this support is located within a functional area to improve responsiveness and to provide assistance with new technology at the local level. In some cases this functional support has come in the form of a centralized, discipline-oriented unit, providing, for example, statistical computing support.

Advantages:
- better understanding of functional areas' needs
- immediate response
- functional area sets priorities

Disadvantages:
- career path problems
- lack of influence on institution's needs
- limited access to new technology and global perspective for computing within the institution
- quality control — who evaluates work of individual
- high risk investment if/when person leaves

Summary

These four organizational models represent ways in which the institution can address the challenge of supporting end user computing. The application of a model to an organization is dependent on many factors, such as those key factors discussed previously. The manner in which computing evolved at the institution and the overall organizational structure help to determine whether one model will work better than another. The purpose of describing these models is to raise the level of awareness that different organizational structures for supporting end user computing do exist. In the next section, a description of converging cultures and converging technologies is presented, along with a new proposed model for supporting end user computing across the entire institution.

Converging Cultures or Converging Technologies

The number and diversity of end users are accelerating at the same time the variety of new technologies to be assimilated according to Nolan's 'Stage Theory' is also increasing. Administrators, students, and faculty recognize a need to merge information from a variety of sources and to use new digital technologies for the communication of knowledge. Similar technologies are often used to accomplish dissimilar tasks. The tools one uses to combine the results of a literature search with the analysis of experimental data or mathematical model are similar to the tools used to select and sort information from a student data base, using the results to generate custom letters. The lines between the technologies, as well as the skills required to use and support them, are growing faint, as are the differences between the 'traditional' support units — the academic and administrative computing centers, the library, institutional research, voice and data communications, audio-visual, printing and video services. The convergence of these technologies and supporting 'cultures' has stimulated considerable interest. While technologies converge, they do so at varying rates:

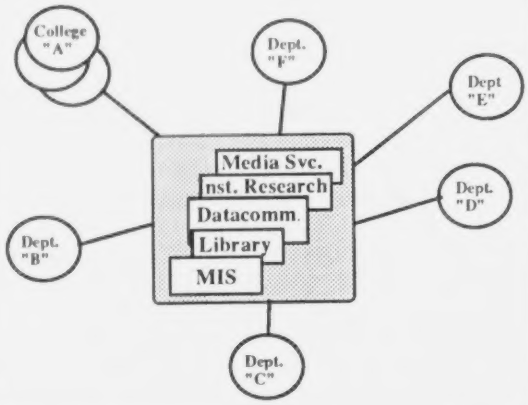
"At any point in time our communities are spread across these stages of growth in very uneven ways. Methodologies that treat all of our people and departments as if they are at the same stage - say integration - simply don't work if a department has just entered the contagion stage. And, as new technologies become real, a mature department or individual may in fact begin a retracing of the growth stages." (Ernst and Shaw, 1984, p. 12).

Since "Organizations change much more slowly than technology and must grow to productively assimilate new information services. " (McFarlan, 1983, p. 37) an organizational model which can handle both the diversity of end users and support cultures while dealing with dynamic technologies is needed.

The Federal model

An organizational model for information services which combines decentralized "entrepreneurial information-related behaviors by business units" with centralized planning, control and support of technologies has been proposed by Robert Zmud (Zmud, 1986) and others. The local units provide functional/discipline related support, while central units "insure that these behaviors are not detrimental to the enterprise's information technology posture in either the short or long run." This federal model, shown in Figure 12, can be adapted to higher education institutions' efforts to accommodate multiple "Nolan curves" by providing end user computing support from several sources.

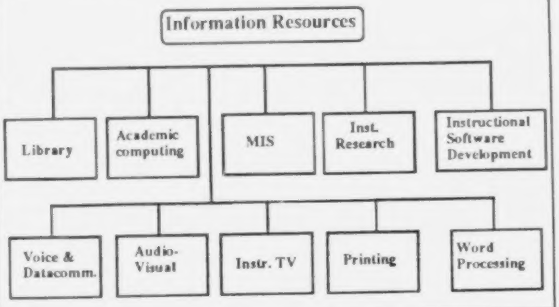
Figure 12. Logical Organization


College "A"
Dept. "F"
Dept "E"
Media Svc.
nst. Research
Datacomm.
Library
MIS
Dept. "D"
Dept. "B"
Dept. "C"

Centralized units, such as those within an academic or administrative computing centers, may provide high-level technical support and guidance and help to establish institution-wide guidelines which implement the institution's strategic information technology plans. Such centralized units are quite similar to the organizational models which provided centralized end user support, either within the MIS department or as a separate unit, and have similar strengths and limitations to those organizations.

The local end user support "businesses" provide a better understanding of functional areas' needs and can respond quickly to those needs. With the support of central units, many of the disadvantages of the Function/Discipline model are overcome, especially the access to new technology and a lack of global perspective.

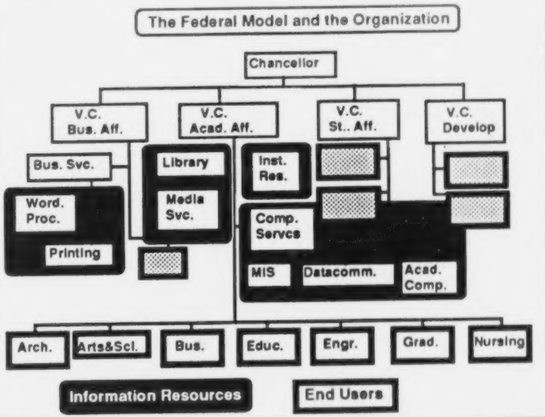
Figure 13. Formal Central Organization


Information Resources
Library
Academic computing
MIS
Inst. Research
Instructional Software Development
Voice & Datacomm.
Audio-Visual
Instr. TV
Printing
Word Processing

The federal model proposes that the Information Resources Center or its equivalent be the central facilitator in developing and maintaining a healthy information economy in the institution. A formal central organization (Figure 13) which manages all of the technology-based support organizations in the institution would provide a high degree of coordination in some institutions.

In other institutions, combining libraries, computing centers, et. al. would be difficult because of the diversity of cultures — education, salary scales, career opportunities, professional organizations, and priorities. These institutions find that an informal combination (Figure 14) of centralized information resources combined with discipline-oriented support resources provides an appropriate balance between flexibility and effectiveness.

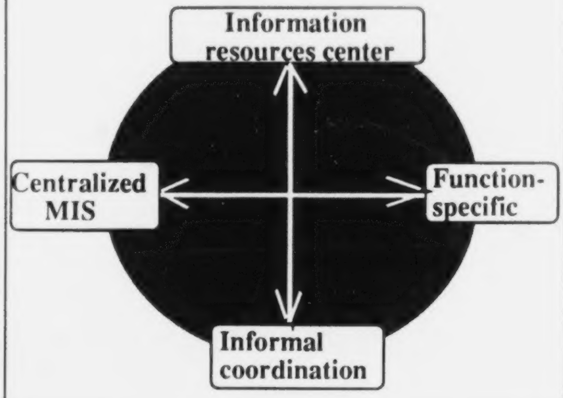
Figure 14. Informal Organization


The Federal Model and the Organization
Chancellor
V.C. Bus. Aff.
V.C. Acad. Aff.
V.C. St.. Aff.
V.C. Develop
Bus. Svc.
Library
Inst. Res.
Word. Proc.
Media Svc.
Comp. Servcs
Printing
MIS
Datacomm.
Acad. Comp.
Arch.
Arts&Sci.
Bus.
Educ.
Engr.
Grad.
Nursing
Information Resources
End Users

The two essential ingredients in both implementations are the provision of first line, distributed support staff who are familiar with the particular needs and capabilities of a group of faculty or staff members, and a second line, centralized support staff who are familiar with a variety of technologies which can be used to meet the needs of various end users.

The two dimensions — centralization vs. distributed user support and formal Information Resources Center vs. informal coordination, may be considered together (Figure 15).

Figure 15.



An institution which has previously focused on a formal, centralized information resource can move in the direction of increasing distributed user support by shifting resources — staff, equipment, space, etc. — towards department or discipline-oriented support. Similarly, an organization which has depended on many decentralized support groups but lacks central coordination can apply existing or new resources to implement the federal model described above. The center of both of these dimensions provides institutions with an opportunity to combine the advantages of several of the end user support organization models in a way that allows them to meet the challenge of the ongoing evolution of end user computing support in higher education.

References

Atre, Shaku . Information Center: Strategies and Case Studies. Atre International Consultants, Inc.: New York, 1986.

Burkin, Wayne. "A Framework for Information Centers." Paper presented at the Triangle Area Information Center Users Group, Raleigh, North Carolina, March 1985.

Emery, James C. "Developing a Strategy for Information Technology in Colleges and Universities." Presentation, EDUCOM, October 1984

Ernst, David J. and Shaw, Edward E. "Managing Information in a University: Real or Imaginary?" Keynote address, Computing for Higher Education in the 80's – An Executive Overview, California State University, Long Beach, California, January 1984.

Gerrity, Thomas P. and Rockart, John F. "End-User Computing: Are you a Leader or a Laggard?" Sloan Management Review, Summer 1986, pp. 25-34.

Licker, Paul S. Fundamentals of Systems Analysis with Application Design. Boyd and Fraser Publishing Company, 1987, p. 652.

McFarlan, F. Warren and McKenney, J. L. Corporate Information Systems Management: The Issues Facing Senior Executives. 1983, p. 37.

Nolan, Richard L. "Managing the Four Stages of EDP Growth." Harvard Business Review, January/February 1974.

Nolan, Richard L. " Managing the Crises in Data Processing." Harvard Business Review, March/April 1979.

Nolan, Richard L. "Managing the Advanced Stages of Computer Technology." The Information Systems Research Challenge. McFarlan, F. Warren, Ed., Harvard Business School, 1984.

O'Riordan, P. Declan. " The Emerging Role of the Chief Information Officer." Information Strategy: The Executive's Journal, Winter 1986.

Zmud, Robert W., Boynton, Andrew C., and Jacobs, Gerry C. "The Information Economy: A New Perspective for Effective Information Systems Management." Data Base, Fall 1986.

Establishing an Information - Intensive Health Science Center

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In the late 1970's the leadership of the University of Tennessee, Memphis adopted the goals of becoming a major biomedical research institution, recognized for excellent academic programs, a model of innovative health delivery and a national information resource. Essential to the accomplishment of these goals were modern laboratories and research equipment, adequate support services and resources to attract and retain the other key factor, top-notch research teams. This presentation deals with one of the support services, an information intensive environment.

It was felt by the leadership of the campus that the ability to manage information transfer would place UT, Memphis in a strategic position to pursue the goals mentioned before. Indeed, it was felt that lack of that ability - to manage information transfer - would significantly inhibit UT, Memphis's ability to compete for research funds and investigators. The four hundred-odd miles separating the health science center campus and the UT, Knoxville campus in addition to the unique needs of the biomedical academic community mandated the development of major computational and telecommunications systems.

As opportunities arose, resources were employed so as to move in the direction of creating the information intensive environment. In 1979 discussions began which resulted in the purchase of a telephone system for the UT, Memphis campus. As the campus was being wired, it was decided that two coaxial cables should be installed, connecting all existing buildings on campus. These later became the basis for a broadband network for the campus. A networking strategy evolved which involves voice, data, and image communications via a variety of technologies (broadband, ethernet, microwave, fiber optics, etc.). A decision was made to merge the small existing but separate academic and administrative computing operations. This lead to the development of a division of computer sciences. As a result of retirement and other factors the Graduate School of Medical Sciences was reorganized and expanded to include academic departments of Biomedical Engineering, Biostatistics and Epidemiology, Comparative Medicine, Computer Sciences and Information Sciences (Library). These new departments were charged with academic and service responsibilities. After a needs assessment of the UT, Memphis Campus, vendors were invited to present a program of mutual synergistic benefit over a long period of time. The result is a multivendor environment of networked (Ungermann-Bass Net One) workstations (Apple, DEC and IBM) using a central minicomputer (VAX8600 cluster) with telecommunications (South Central Bell) to other data bases or main frames.

The Chancellor of UT, Memphis made the commitment to capitalize the critical mass of hardware, software, personnel and space necessary to begin to meet the needs of the health science center. Recently additional commitments have been made to expand the capacity and capability of the information intensive environment. This paper details the key factors and developments in this six year process.

In 1982, the leadership of UT Memphis, most notably, Chancellor James C. Hunt, M.D., set as a goal for the institution that of becoming an information intensive campus. In realizing this goal of an information intensive campus, UT Memphis will provide an environment in which good people may have whatever information technology proves advantageous in accomplishing its mission of excellence in biomedical research, delivery of health care services, and health professions education. Also, the university will provide electronic access to all forms of information by faculty, staff, and students in a timely and effective manner. The chancellor felt the long term success of the university depended heavily on whether or not this goal was reached.

STRATEGY FOR ACCOMPLISHING GOAL

The university will accomplish the goal by maximizing the use of the following information technologies: state-of-the-art computing technologies; cutting edge telecommunications systems including fiber optics, microwave, broadband, and satellite transmission; advanced image transfer capability for ultra sound, CT, PET, MR, and x-ray; relational database systems and fourth generation development software.

STEPS TAKEN TO PROVIDE THIS ENVIRONMENT

CREATION OF SERVICE DEPARTMENTS

Starting in 1982, the Chancellor created the first of several service departments. The first was the department of education which provides support services for health science instruction and biomedical research. The second was the department of computer science which provides computing and telecommunications services. The third was the department of biostatistics and epidemiology which provides statistical design and analysis. Each of the three departments have faculty who engage in teaching and research, but the primary role is support service.

MODERN COMPUTING CAPABILITY

The university leadership recognized that a rich computing capability is the keystone to an information intensive campus. In 1983, after twelve months of evaluation, UT Memphis chose the DEC VAX architecture for its computing system. The easy to use VMS operating system and the ability to cluster CPU's were key factors in the decision. The Health Science Computing Center (HSCC) consists of a VAX cluster of an 8650, an 8700, and an 8800, along with several PDP 11's.

In addition to the hardware, the university has invested heavily in software to support instruction, researcher, patient care, and administrative activities. Such software products as ORACLE, ALL-IN-ONE, Video Text, RS1, LIMS, SAS, SPSS, BMDP, etc. have been installed.

STATE-OF-THE-ART COMMUNICATIONS NETWORK

Because the university is in the business of creating, storing, retrieving, and transferring information, it needs an extensive, fast, and reliable communications network. A campus-wide broadband backbone connects all 23 major campus buildings along with other non-UT buildings in the medical community. Both broadband and baseband is used for intra building wiring. Ethernet is used where megabit speed is needed for processor to processor and image transfer. Presently, there are over 1500 users on the network. The broadband is also used to transmit video signals about the campus.

ACCOMPLISHMENTS

VAX 8xxx cluster
State-of-the-art software
Campus-wide local area network(LAN)
Microcomputer laboratory
Extensive computer literacy/training program
Satellite teleport(uplink and three downlink dishes)
Modern NT SL-1 voice switch
Video distribution
Library information system

Student information system
Office automation/ electronic mail

DETAILS OF ACCOMPLISHMENTS

VAX 8XXX CLUSTER

The university has three VAX 8xxx processors in the cluster with approximately 25 MIPS capability and 15 gigabyte of disk storage.

STATE-OF-THE-ART SOFTWARE

A relational database and fourth generation development language is being used to develop many of the corporate systems. DEC's All-In-One office automation system is meeting the electronic mail, office management, scheduling, etc. needs. Laboratory information management and researcher's electronic notebook packages are assisting the researchers.

CAMPUS-WIDE LOCAL AREA NETWORK(LAN)

A mid-split broadband cable plant serves as the backbone of the campus local area network. Both ethernet and terminal traffic are being transmitted over the system. Also, security and television distribution is part of the network. Via the network, over 1500 users can access all of the CPU's at the central facility or any CPU connected to the LAN.

MICROCOMPUTER LABORATORY

A microcomputer laboratory containing almost 100 devices serves as an open access facility for faculty, staff and students and also as a site for most of the training and computer literacy activities. A variety of makes such as Apple II's, Macintoshes, IBM PC's, DEC Rainbows, and DecMates make up the lab. Most of these devices are connected to the LAN so they can be used in a stand-alone capacity or as an intelligent terminal to the central site CPU's.

EXTENSIVE COMPUTER LITERACY/TRAINING PROGRAM

The university is in its fourth year of an intensive computer literacy program in which some 500 faculty/staff have participated in the literacy training. Eight week Micro based training for the Macintosh and the IBM PC has attracted many faculty to participate. Some time is given to the use of the network and how to access and use the VAX cluster and the PDP 11's.

SATELLITE TELEPORT(UPLINK AND THREE DOWNLINK DISHES)

The very recent installation of a seven meter KU-band uplink disk to go along with three downlink dishes(two KU and one C band) gives the university a first rate teleport capability. The first transmission, a dental continuing education program, will occur December 5, 1987. In addition to teleteaching, the teleport uses will include teleconferencing, telemedicine, and data transfer.

MODERN NORTHERN TELECOM SL-1 VOICE SWITCH

The switch is meeting the voice needs of the campus. Also, Integrated Services Digital Networking (ISDN) is being looked at very closely at this time.

LIBRARY INFORMATION SYSTEM

The Georgetown Library Information System(LIS) has been purchased, is being implemented and will be be accessible via the LAN from office, dorm, or home. The seven teaching hospitals in the Memphis medical community will be able to access the library's medical holdings.

OFFICE AUTOMATION/ELECTRONIC MAIL

Electronic mail has really caught on and is being used instead of the telephone by many on campus.

BIOMEDICAL INFORMATION TRANSFER (BIT) CENTER

Realizing that information was rapidly becoming as important a commodity as money, people, and space, the university has chosen to pull together those functions that impact directly on information by establishing the Biomedical Information Transfer(BIT) center whose mission is:

To facilitate the creation, storage, retrieval, and transfer of biomedical information by coordinating functions including academic and administrative computing; all forms of voice, data, video, image and text communications; automated library system; institutional modeling and research; office automation; user services and technology training.

The BIT Center will consist of the following sections:

- Computing Systems
- Technology Services
- Information Systems
- Telecommunications Services

The goal of the BIT Center is to assist the university to realize its mission of excellence in biomedical research, health science education, and patient care.

ESTABLISHING AN INFORMATION RESOURCE MANAGEMENT ORGANIZATION AT CAL POLY

by

Dr. Arthur S. Gloster II
Vice President for Information Systems

California Polytechnic State University
San Luis Obispo
California

Abstract

The IRM program gave CSU campuses more authority over local computing and communications resources. Recognizing the vital role information systems would play in Cal Poly's future, the president appointed a task force to analyze the IRM organization. The task force recommended organizational changes, including hiring a Vice President for Information Systems, and a commitment to user-driven planning. Implementing the IRM organization provided further challenges. Hiring the new Vice President, new fiscal constraints, inadequate staffing, and resistance to change hampered implementation. Long-term benefits included increased systemwide and industry visibility; proactive, creative leadership; completion of pending projects; user-driven planning mechanisms; and a cohesive organizational structure.

California State University (CSU) Executive Order No. 447, Information Resource Management Program, November 30, 1984, established a framework for effective systemwide and campuswide planning and management of information and information technology in support of the overall mission, goals and objectives of the CSU system. The basic campus planning process is depicted in Figure 1. Under the executive order, each CSU campus President was delegated authority to approve computing and communications procurements totalling less than $100,000 per year. The idea was to grant more autonomy to the campus to determine and expedite its information needs. Projects exceeding $100,000 per year would continue to be forwarded to the Office of Computing and Communications Resources (CCR) at the Chancellor's Office. Approval from the California State Department of General Services would also be required.

The new framework required each CSU campus to review its current practices and establish a formal mechanism for planning, evaluating and managing computing and communications resources. This framework had to address planning, approval, budgeting, procurement, contracts management, accounting, reporting, and evaluating of all campus computing and communications projects through a single campus entity, the IRM designee. This individual would ensure that projects were congruent with an overall strategic plan for computing and communications designed to meet the unique programmatic needs of academic and administrative users at each campus. The programmatic needs, target environment, budget request, project plans and inventory of campus resources would be detailed in the annual Campus Information Resources Plan.

During this same period, Cal Poly was undergoing an extensive process of total self-evaluation, with the goal of developing a plan to address its future over the next decade in a constantly changing environment. The campus evaluated its strengths, its unique educational philosophy and its place in the hierarchy of California higher education. A mission statement and goals emerged into a formal document that was given as a presidential address at the Fall 1985 Conference of Faculty and Staff.

Cal Poly's new mission statement emphasizes disciplines and teaching methods that enable graduates to succeed in the professional "world of work." High priority is given to the development of the individual student in an environment that encourages "learn by doing." Emphasis is on the applied and practical without diminishing the importance of principle and theory. As a polytechnic university, arts, humanities and science must play a fundamental role. The development of the total student is a primary objective and must provide a foundation for continual learning and productive citizenship.

The goals of the University to support this mission are:

1. A commitment to the individual;
2. A commitment to quality undergraduate education;
3. A commitment to an emphasis on the polytechnic
4. A commitment to a strong liberal component of education for all students; and
5. The development of graduate programs that build on our strength, have a positive influence on the graduate programs, and foster interdisciplinary activity among the faculty.

With this strong directive from President Warren Baker as a backdrop, the campus evaluated its potential to accomplish these goals. It was immediately recognized that information resources and their management would play a key role in determining the ultimate success of Cal Poly and accomplishment of its goals. However, the campus did not have a strong, overall strategy or plan for addressing its needs in the area of computing and communications resources.

Over the years, the computing organization had undergone several changes in management structure and reporting authority. It began as a fairly traditional campus computing center initially concerned with meeting administrative data processing needs and supporting the technical disciplines such as computer science and engineering. The changing technology and the concurrent decrease in cost made it possible for computers to be integrated into a wider range of disciplines and administrative processes. Decentralized computing accompanied a decreased dependency on the central computing organization for mainframe support but an increased need for user support.

As campus needs changed, so did the computing organization. The computing and communications organization was now viewed as a campuswide resource with diverse responsibilities. Decisions could have major impact on the university's future. A new advisory position, Associate Provost for Information Systems, was created to reflect the higher level of responsibility, control and planning accorded computing and communications.

The new organization was charged with supporting three levels of computing: mainframe, minicomputers and microcomputer. Major functions included the computer center, user services, voice and data communications, and a systemwide CAD/CAM project for academic computing.

This transition took several years and was traumatic. The Information Systems organization experienced several years of interim management. Strategies, direction, philosophy, and organization structure changed with each succeeding change in leadership. There was a growing disenchantment with the overall quality of service and responsiveness to user needs. Because of the reluctance of interim management to make long range plans, the computer center was perceived as a "reactive" rather than "proactive" force for change. There was a growing concern over the apparent lack of vision and leadership within

Information Systems to develop and drive a central computing organization consistent with the new mission, goals and objectives of the university.

This posed a major problem for the President. Several major computing and communications projects impacting the future goals and directions of the university were pending. These included replacement of the current administrative and academic mainframe, implementation of a campuswide data communications, replacement of an antiquated telephone system, and satisfying the diverse needs of an academic community ranging from general education to advanced technology disciplines. Decisions had to be made soon. The President realized that a door was closing; if the university didn't act soon, an opportunity would be lost.

For Cal Poly, establishment of an IRM framework presented an opportunity to examine the role of information systems in relation to its entire academic and administrative community and to seek solutions to these pending projects. Coupled with the need for a formal campuswide IRM planning framework, the President decided to act.

In September 1985, the President appointed a 10 member task force to review the IRM organization. Representing a broad spectrum of interests, the task force included five representatives appointed by the Academic Senate, three appointed administrators, and the chairs of the two campuswide advisory committees on computing. Members were selected based on their past experience with and knowledge of computing and communications at Cal Poly.

The committee was charged with two primary tasks. They were to:

1. Recommend alternative organizational models, identifying functional areas for inclusion and defining relationship with existing advisory committees

2. Recommend appropriate level of experience, expertise, skills and qualifications to administer the recommended IS organizational model, i.e., develop a position description, course of action (recruitment, appointment, etc.)

Related to the above, the committee was asked to look at mechanisms for increased user input and feedback regarding IS activities and IRM planning. The task force reviewed several organizational units with connections to Information Systems. These included the Computer-Aided Productivity Center (CAPC); Computer Services charged with managing the central mini and mainframe computer hardware and software and related user consulting services; and Microcomputer and Telecommunications Services. The latter group included telephone services, user consulting and technical support for microcomputers, and central hardware and communications equipment installation, maintenance and repair. Peripheral units reviewed included Audio-Visual Services which supported academic and administrative offices with graphics, photography, and the delivery of media support (filmstrips, videotapes, etc.) to the classroom. A-V had been instrumental in developing a coaxial video cabling plant on the campus which supported data as well as video communications. Finally, because of the increasing emphasis on electronic information, the library was included in this review.

In December 1985, the task force issued its recommendations. These can be summarized as follows:

1. Elevating the leadership role for Information Systems to that of Vice President reporting directly to the President. A position description was developed and submitted to the President with the task force recommendations. The level of Vice President was recommended because Information Systems transcended all university operations, and the designation was consistent with trends at other institutions.

2. Establishing a long range planning unit with a reporting relationship to the Vice President and appropriate planning and data base management elements within Information Systems. A commitment to the principle of user driven planning was seen as critical to address campuswide concerns that decisions were being made in a vacuum and not derived from user needs.

3. An organizational structure designed to eliminate duplication in service offerings. This structure should separate administrative and academic computing, retain the CAPC function, establish a data base management and planning units, and provide software consulting services irrespective of hardware.

Two alternative organizational structures were presented to the President for consideration (See Figures 2 and 3). For the time being, the task force recommended excluding the library and portions of Audio-Visual Services from the Information Systems organization because of the number of computing, networking and telecommunications projects that needed to be addressed coupled with concerns of library staff. At the same time, the task force acknowledged need to direct additional personnel, operating expenses and equipment resources to IS to meet current and emerging needs.

The task force identified long-term benefits of the proposed IRM organization as increased systemwide and industry visibility through proactive and creative information systems leadership; implementation of major computing and communications projects; establishment of a user-driven strategic planning mechanism; and a strengthened organizational support structure which reduced redundancies and clarified responsibilities.

The full support of the President was a key to implementing the new IRM organization. The position of Chief Information Officer was created at the Vice President level and a nationwide search was conducted. However, recruitment took longer than anticipated and created the initial challenge to the new organization's success.

When the new Vice President was appointed in December 1986, the campus faced several challenges. The "pending" projects had reached critical milestones. The administrative mainframe project had been abandoned; equipment for the campuswide network had arrived but IS lacked the manpower to install it; the telephone project was proceeding slowly; the budget situation was worse than anticipated; resistance to change at the systemwide and campus level; reluctance to allocate resources to IS projects; and disagreement over the rate at which change should take place. Recognizing the urgent need for additional manpower to accomplish these projects, the President facilitated permanent transfer of Audio-Visual Services in its entirety and temporary transfer of other resources to Information Systems.

With these transfers, the new Information Systems organization emerged as five separate and distinct entities: Academic Computing Services, Administrative Systems (including an End User Support group and Data Base Administrator), Communications Services (including Audio-Visual Services), Computer Operations, and Specialty Center (including CAPC). The new organizational structure and emphasis are depicted in Figures 4 and 5.

In keeping with the task force recommendations, a new ad hoc Information Systems Policy and Planning Committee was formulated. Chaired by the new Vice President, committee membership consisted of three administrative and three faculty representatives. Their first charge would be to formalize a plan for academic computing.

The new IRM organization was able to take a proactive role with industry. Recognizing that new computing equipment is costly and that funding constraints placed on the CSU campuses made it difficult to keep pace with changing requirements, creative solutions had to be found. With its Vice Presidents for Information Systems and University Relations, Cal Poly now had a team that could actively seek relief in the private sector.

The new organization has been in place for nearly a year now and its success is evident. Campus attitudes and perceptions of Information Systems have undergone a complete turnaround. There is a perception of Information Systems as responsive to user needs. While service levels and contacts are still being defined, avenues of communication between Information System and campus users are much stronger and clearer than ever before.
This strengthened relationship can be attributed to three major factors:

First, the "pending" projects of a year ago have been completed far earlier than anticipated. Through a joint study project with IBM and Information Associates, the campus has a new administrative mainframe and is in the process of developing a DB2-based student information management system. The campuswide data network is up and running, connecting numerous users to the central computing resources. Touchtone telephones and Centrex service have replaced a thirty year old Western Electric 701 relay switch.

Secondly, the new user-driven planning committee is an enthusiastic proponent and vital element of the new IRM organization. They are actively involved in determining the future direction of computing and communication at Cal Poly. They are charged with developing the strategic plan for computing and communications to be implemented by Information Systems. They are key to communicating and representing the users. This process started in Fall 1987 with an academic computing planning session.

Thirdly, the involvement of industry is key. Negotiations are underway with several vendors to increase the computing capacity in the academic curriculum at minimum expense to the university. Building on its OASIS and CAPC projects, Cal Poly is current being considered for designation as an IBM Specialty Center for the entire CSU system. This specialty center would offer an IBM environment to all 19 CSU campuses to support Schools of Business and other applications. IBM, Hewlett-Packard, Apple Computers, Digital Equipment Corporation, Pacific Bell, MSA, Arthur-Anderson, Northern Telecom, and others are actively negotiating with Cal Poly regarding outright donations of hardware and software, special discounts, research and development efforts, and more.

Finally, the major benefit of the new IRM organization is the intangible yet real sense of direction and proactive leadership within Information Systems. In a recent issue of U.S. News and World Report, Cal Poly was cited for national recognition among colleges and universities in the West. This recognition challenges the university to maintain or exceed current levels of academic excellence, especially in the area of advanced technology. Computing and communications resources are an essential element in this challenge. To provide the necessary resources, Cal Poly's IRM organization must continue to be creative and proactive. It is only through innovation, positive thinking and take charge actions that Cal Poly can achieve the kind of computing and communications environment to match its reputation for excellence.

FIGURE 1

IRM PROGRAM

Planning Framework

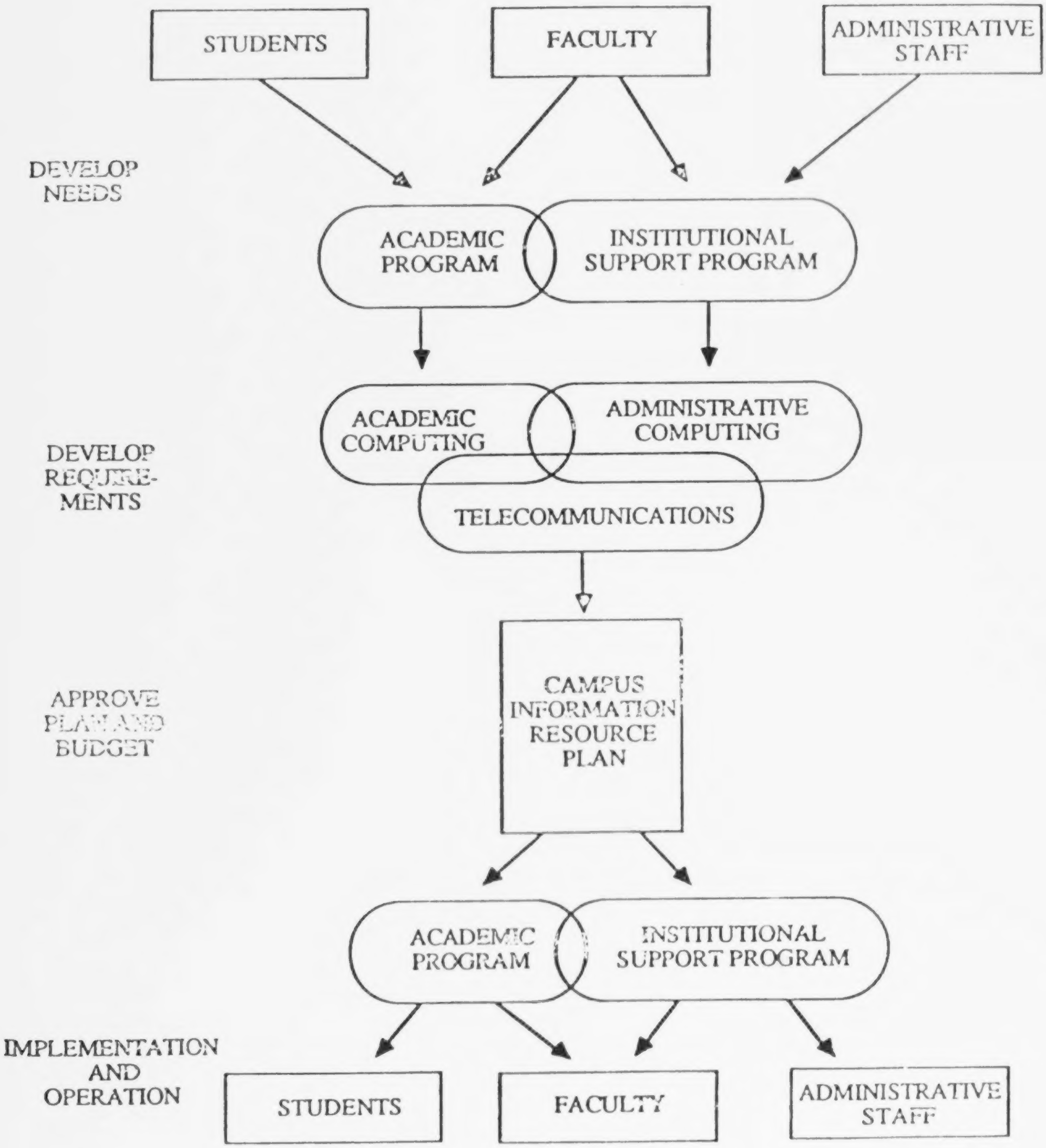
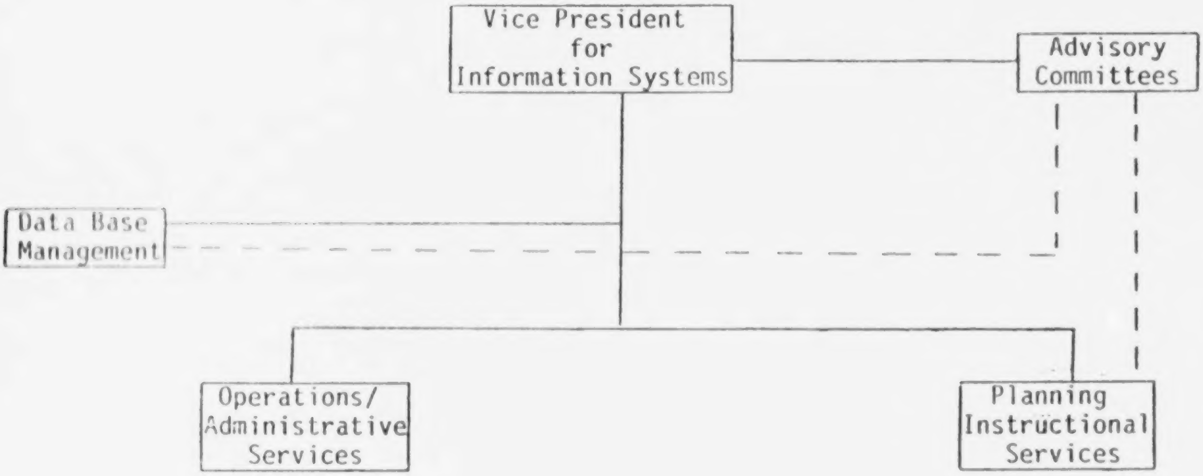

STUDENTS
FACULTY
ADMINISTRATIVE STAFF
DEVELOP NEEDS
ACADEMIC PROGRAM
INSTITUTIONAL SUPPORT PROGRAM
ACADEMIC COMPUTING
ADMINISTRATIVE COMPUTING
DEVELOP REQUIREMENTS
TELECOMMUNICATIONS
APPROVE PLAN AND BUDGET
CAMPUS INFORMATION RESOURCE PLAN
ACADEMIC PROGRAM
INSTITUTIONAL SUPPORT PROGRAM
IMPLEMENTATION AND OPERATION
STUDENTS
FACULTY
ADMINISTRATIVE STAFF

FIGURE 2

INFORMATION SYSTEMS ORGANIZATION STRUCTURE
ALTERNATIVE 1


Vice President for Information Systems
Advisory Committees
Data Base Management
Operations/ Administrative Services
Planning Instructional Services

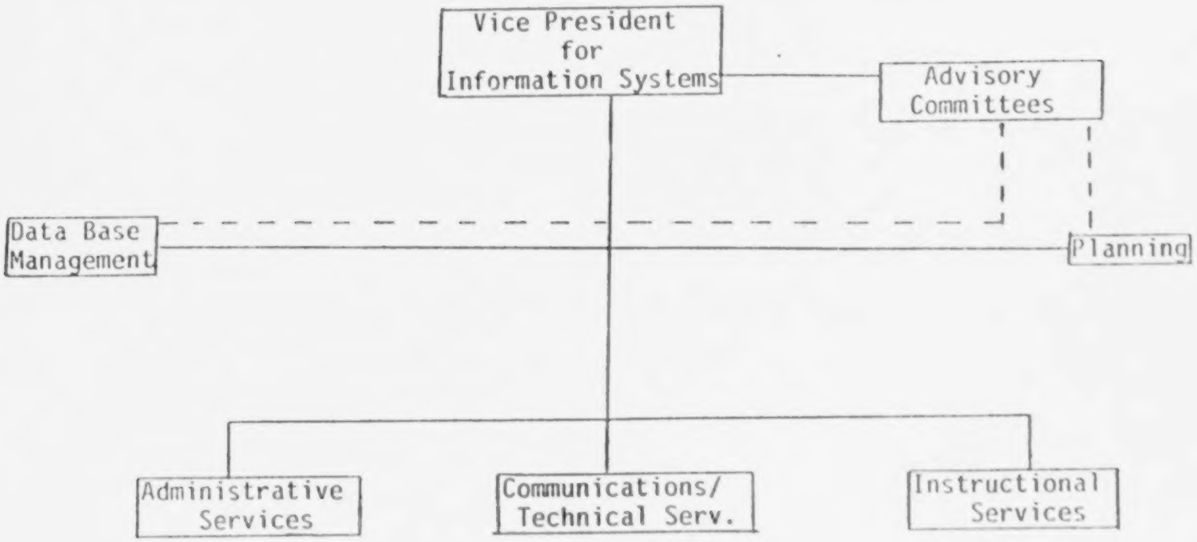
- -Adm. H/W Oper./Sys.*
- -Adm. Application S/W Support
  - -Maintenance
  - -Development
  - -Consulting
  - -Training
  - -Installation
- -AIMS
- -Office Automation
- -Communications/Networks
  - -Telephone/Voice
  - -Data
  - -Alarm
  - -Video
  - -WANS
  - -LANS
  - -Environmental Controls
- -H/W and Network installation & repair

- -Inst. H/W Oper./Sys.*
- -Inst. Application S/W Support
  - -Maintenance
  - -Development
  - -Consulting
  - -Training
  - -Installation
- -CAPC
- -Inst. Computer Labs
- -Planning

(*) Assumes adequate staffing to effect separation of instructional and administrative operations and systems support - otherwise combine activities under Operations/Administrative Services.

FIGURE 3

INFORMATION SYSTEMS ORGANIZATION STRUCTURE
ALTERNATIVE 2


Vice President for Information Systems
Advisory Committees
Data Base Management
Planning
Administrative Services
Communications/ Technical Serv.
Instructional Services

*-Admin. H/W Operations/ Systems Support
-Admin. Applications S/W Support
  -Installation
  -Training
  -Maintenance
  -Development
  -Consulting

-AIMS

-Office Automation

-Communications/Net.
-Telephone/Voice
-Data
-Alarm
-Video
-Environ. Controls
-WANS
-LANS
-H/W & Network install./repair

*-Instr. H/W Operations/ Systems Support
-Inst. Applications S/W Support
  -Installation
  -Training
  -Maintenance
  -Development
  -Consulting

-CAPC Workstation Lab

-Inst. Workstation Labs

* Assumes adequate staffing to effect separation of instructional and administrative operations and systems support - otherwise combine activities under Administrative Services.

FIGURE 4

Information Systems Organization Chart

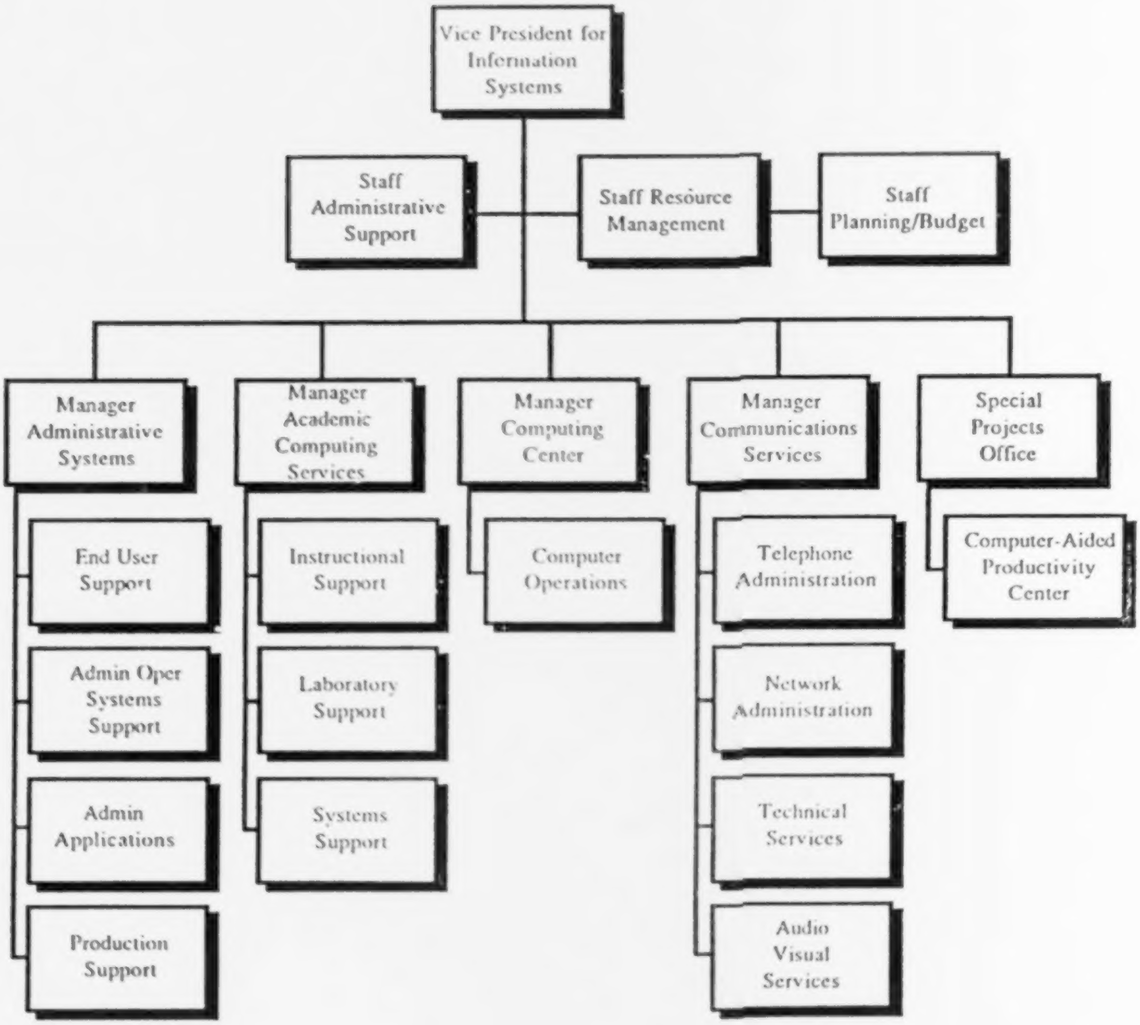

Vice President for Information Systems
Staff Administrative Support
Staff Resource Management
Staff Planning/Budget
Manager Administrative Systems
Manager Academic Computing Services
Manager Computing Center
Manager Communications Services
Special Projects Office
End User Support
Admin Oper Systems Support
Admin Applications
Production Support
Instructional Support
Laboratory Support
Systems Support
Computer Operations
Telephone Administration
Network Administration
Technical Services
Audio Visual Services
Computer-Aided Productivity Center

FIGURE 5

Information Systems . . .Who We Are

Academic Computing Services

Academic Computing Services (ACS) is charged with planning for and meeting the academic computing needs of the university by enabling Cal Poly faculty and students to gain access to vital computing resources to conduct their academic endeavors and providing professional support services in an environment conducive to learning.

ACS provides the following services:

- o **Operating Systems Support** programs and manages centrally supported academic minicomputers and mainframe systems.
- o **Instructional Support** services, consults and trains faculty and student users on centrally supported microcomputer, minicomputer, and mainframe resources.
- o **Laboratory Support** plans for and manages centrally supported campus microcomputer and terminal lab facilities
- o **Computer Accounts** issues and maintains individual and class accounts, and implements access policies for campus minicomputer and mainframe systems.

Communications Services

Communications Services plans, coordinates, facilitates, implements, maintains and manages all campuswide communications resources including but not limited to telephones, broadband and baseband data, television, satellite, radio, paging, voice amplification, visual presentation, and alarm/life safety support systems.

- o **Telephone Administration** provides and administers necessary telephone services to all campus users.
- o **Data Network Administration** provides data communications management and support for campuswide data communications resources.
- o **Technical Services** provides campuswide installation, maintenance and support services for all Information Systems operations.
- o **Audio Visual Services** maintains adequate classroom and laboratory facilities and the necessary equipment to provide comprehensive audiovisual aids to learning.
- o **Engineering Services** plans, designs, documents, maintains files and libraries, and engineers communications systems to meet the needs of all areas of Communications Services.

Administrative Systems

Administrative Systems (AS) plans, implements and facilitates the use of computing technology, including administrative data, to support the day-to-day operation and management of the university and its various academic programs, activities, and functions.

AS incorporates the following subgroups:

- o **End User Support** provides a central contact point for training and consulting on computing resources and data available to administrative users.
- o **Operating Systems Support** implements, maintains and monitors system software utilization on centrally supported administrative mainframe to ensure optimum access by users.
- o **Applications Development** analyzes, designs and implements computing oriented solutions to specific university problems.
- o **Production Support** handles the day-to-day processing of administrative applications (grades, CAR forms, etc.) and program maintenance and library management functions for all operational central administrative systems.

Computer-Aided Productivity Center (CAPC)

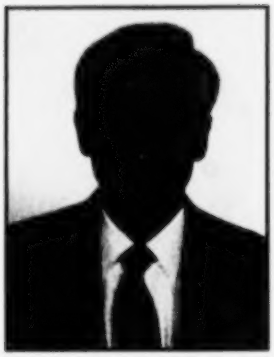
CAPC is a CSU speciality center devoted to the support of academic programs in the areas of computer-aided drawing, design, and engineering analysis. The primary software products utilized stem from an IBM university grant which included an IBM mainframe, high resolution graphics terminals, and a number of speciality software products. The Center's resources are open to all academic programs, with past usage primarily from engineering and architecture.

Computing Center

The Computing Center plans, manages and implements policies and procedures controlling the day-to-day activities within the actual machine room where the centrally supported hardware resides.

- o **Operations** is responsible for supervising the delivery, installation, operation, maintenance, and disposal of centrally supported hardware. In conjunction with this, they handle routine and emergency system shutdowns; plan, manage and control access to the machine room facilities; monitor machine performance and environmental conditions; deliver user printouts; and order routine supplies and services.

Track IV
Support Services



Coordinator:
Frank Thomas
University of Akron

In order to take full advantage of information technology, support units must be in place at all levels—consulting, education, maintenance, data access, systems development, security. Papers in this track describe the ways in which many institutions are redefining responsibilities and creating new opportunities to meet support needs.

Top: Karen L. Miselis, University of Pennsylvania. Below: Mary Wilson, Baldwin-Wallace College

Steven Saltzberg, California State University/Fresno, and Paul Tumolo, California State University/Hayward

APPLICATION DEVELOPMENT CENTER

John F. Leydon
USNH Computer Services
University of New Hampshire
Durham, N.H. 03824

The key to a highly productive Systems Development department is the proper use of a powerful Fourth Generation Language (4GL). The best method to insure the proper use of a 4GL is the successful operation of an Application Development Center (ADC). This presentation will provide the methods necessary to justify, plan, organize and implement an ADC. Techniques will be discussed to insure the successful use of a 4GL under the auspices of a development center. The two concepts (ADC and 4GL) are intertwined and inseparable if it is desired to get the maximum efficiency of the human resources involved in systems development.

The Application Development Center

presented by
John F. Leydon
George Kaludis Associates
and the
University System of New Hampshire

The time has arrived for data processing professionals to apply the tools and techniques of systems automation to the processes that have been used to automate the work environment in other departments. In most organizations the least automated functions are the systems analysis, systems design, programming and documentation techniques used by systems development personnel. The past few years have produced a tremendous number of automated assistances to aid the process of systems development. The rise of new series of buzz-words has heralded the advent of many new products and concepts. Computer aided software engineering, applications generators, relational data bases, fourth generation languages and information resource management techniques all have a part to play in the process of automating the development process. The challenge today is to collect the separate technologies into one concentrated methodology. The application development center is the mechanism which can provide the cement to bond the loose fitting processes together and establish a wholistic approach to the automation of the systems development process.

To better understand the concept of an Application Development Center (ADC), it would be helpful to envision an information center for systems development professionals. MIS executives have accepted the premise that more work can be accomplished if a small core of systems professionals were utilized to assist and encourage the end user to develop computer systems. Productivity is enhanced in two ways: the end user can immediately translate his needs into computer applications without the assistance of an intermediary, and the systems professional can spend her time automating the applications that require more advanced talents and expertise. It is important that those same MIS executives accept the concept that a small group of experts can improve the productivity of systems personnel by concentrating on the practice of technology transfer to assist the mainstream developer of automated systems. The results can be spectacular; productivity improvements of 50% to 60% are common. Typically, an ADC should be staffed with approximately 10% of the total number of systems professionals. If this 10% can improve the performance of the remainder of the staff by 50%, it is clear that the net result is highly positive.

The concept of an ADC is not new, but it has not caught on in MIS circles. IBM Canada introduced the idea at about the same time the information center concept was sweeping the industry. The information center has fully infiltrated the conventional wisdom and is now beginning to lose favor. The objectives sought with the introduction of the information center have, for the most part, been realized. There is a far more knowledgeable user demanding services of a different nature from our data processing departments. It is advisable to continue to encourage and nurture this type of end user, but a far more lucrative venture awaits our attention. The productivity of MIS developers has remained static for a long period of time. For MIS departments to be successful in the future, new systems will need to be introduced far more rapidly, and the architecture of the systems will need to be conducive to fast modification.

To achieve major improvements in productivity, the entire process of systems development must be automated. Currently, the approach is to mechanize separate units of the development process and assume that the total effort will be enhanced by incrementally improving the individual processes. This approach could be deceptive. Peter Drucker, a well known management scientist, has stated that "the only things that evolve by themselves in an organization are disorder, friction, and malperformance". The automation of systems development cannot be left to chance; the process must be well planned and implemented in a controlled fashion. It would be inconceivable to automate the individual processes of the financial structure of an organization without an overall review of the interactions of the various elements. The same care needs to be given to the application known as "new systems development". The application development center is the mechanism that should be utilized to introduce the wholistic approach to the development process.

ADC Mission

The mission of the ADC is to support the systems and programming staff with dedicated resources to optimize and accelerate development and maintenance of quality application systems. The MIS organization needs to view the development process as an application. The practices and techniques brought to bear on a standard application, such as student records or human resources, must also apply to the systems development application. A project team is formed and provided with a direction statement, a budget, executive support and a requirement to prepare a project plan.

The project life cycle is applicable to this effort, and therefore the team must define requirements, investigate alternative solutions, select a solution, install the product(s), identify modifications, implement the modifications, prepare a test case, present a prototype solution, train the user community, prepare documentation, install the first application, review the results, and prepare to support the application with modifications and enhancements for the life of the product.

The ADC project team must insure that its objectives are in synch with the organization it was formed to service. For example, the team cannot decide that the best solution for the automation of the development process encompasses an environment supported by a VAX/VMS cluster if the university has all its applications running on an IBM mainframe. A more realistic example involves an organization that has set a strategic direction whereby all new systems will be purchased packages from established software vendors. This environment does not diminish the need for an ADC, but the products and processes selected will need to be more in tune with modifying and enhancing third generation software applications.

As an aside, the end is in sight for packaged applications developed in third generation languages. It is quite conceivable that a major investment in such a package at this time could be a significant waste of money. This concept will be further developed in the latter portions of this paper.

As stated above, the ADC is an information center for systems development professionals. As such, it must consist of physical location and a dedicated staff with access to software tools and adequate hardware resources. The idea is to leverage critical skills to increase the performance of all. The MIS executive must face the tough choice of removing the best and most seasoned development staff. It will be a fruitless exercise to initiate an ADC with the least productive members of the MIS organization. The staff is charged with effecting change by emphasizing leadership, responsibility and accountability. The natural response of the general MIS organization will be to resist change. The process will be eased if the ADC staff is recognized and respected professionals who will assume a leadership role to coax their peers to accept the new methods. The type of individual who will thrive in the ADC environment is one who naturally accepts responsibility and will not be satisfied until real improvements in productivity are demonstrable. The responsibility for results is held by the ADC staff, not the systems developers.

ADC Responsibilities

The actual responsibilities of the ADC organization will be as varied as the number of MIS departments employing one. The following list is typical and should be considered as a base to expand or contract to meet the realities of a particular environment:

1. Provide guidance in all aspects of the systems development process.

2. Establish a mechanism to measure the efficiency of the process to demonstrate productivity improvements.

3. Insure the appropriate allocation of hardware and software resources.

4. Insure adequate service levels of development staff.

5. Investigate new methods, tools, and techniques.

6. Train and assist development staff in the use of ADC facilities.

7. Provide data administration and test data system support.

8. Coordinate ADC functions with all other DP areas.

To provide guidance in all aspects of the development process requires a wide range of expertise. This feature of the ADC reinforces the concept that staff must be gleaned from the most experienced MIS personnel. If the full measure of productivity gains are to be realized, all areas need to be improved. The use of a fourth generation language may impact the programming phase of a development effort and bypass any improvement in other areas. The ADC should respond to the entire process and provide assistance in project management, systems design, programming, testing, documentation, and maintenance. Providing improvements to the entire spectrum of the systems life cycle requires that the ADC introduce new technology to improve the tools and techniques and, in addition, stress the analytical aspects of process and methodology.

It would be impossible to determine the success of the ADC without an accurate mechanism to measure the performance of systems development and the productivity gained by the ADC techniques. This area of MIS professionalism is woefully lacking. It is doubtful that 5% of MIS organizations have the tools available to accurately measure productivity. This dilema must be solved to justify the existence of an ADC. Senior management will require tangible proof that the expense of an ADC organization is warranted. The old performance standards will not suffice; the ADC must introduce a mechanism to justify its existence or face elimination.

Previous attempts to measure effectiveness centered on one of two mechanisms:

a. Lines of code produced per unit of work effort.

b. Satisfaction of defined requirements on schedule and within budget.

Both measurements are fraught with inconsistencies and inaccuracies. In fact, lines of code is a moot measure now that non-procedural languages are the norm. Completion of a project on time is more a matter of creative estimating than effective work effort. A better yardstick must be invented, or productivity will never be measured accurately.

Productivity is measured as the result of dividing the work product by the work effort. An effective productivity measure would determine the productivity, demonstrate trends, promote actions to improve work efforts, and show the results of such actions. In addition, the measuring device should support the estimating process by identifying discrepancies. A tool developed by IBM, known as "function point analysis", has the necessary ingredients to be an effective measuring device. This subject could be covered in a future paper if there is sufficient interest.

The ADC must also insure the appropriate allocation of hardware and software resources. In other words, the ADC must get its share. A basic proposition of this paper is to equate the ADC with other major applications, such as student records or human resources. It is very important that the staff of the ADC demand equivalent allocation of resources. It is absolutely essential that each MIS professional have a dedicated terminal and preferably a microcomputer with terminal capabilities. A very attractive environment would provide a stand alone mainframe for systems development to insure that conflicts did not occur with the operation of production systems. Lastly, the need for a 4th generation language is essential, otherwise revolutionary improvements in productivity will not be realized.

As part of providing adequate resources, the ADC must strive to provide optimum performance of the available services. Studies have shown that the productivity of systems developers is directly related to on-line response time. Optimum performance requires subsecond responses. The study revealed that drastic improvements occurred with minor improvements in response time.

The following results were demonstrated when terminal response was reduced from an average of 2.22 seconds to an average of .84 seconds:

a. A 60% increase in transaction rates.

b. Output improvement of 58%

c. A 130% decrease in the error rate.

d. A 37% reduction in overall project cost.

e. A 39% decrease in the elapsed time of the projects.

This phenomenon was not immediately understood by the researchers. An assumption is that the ergonomics associated with terminal response and attention spans of the human brain are optimized when the interval is less than one second.

A rapid turnaround of batch testing procedures is as important as terminal response. Fifteen minutes is suggested as a reasonable elapsed time from submission to completion. Terminal response and batch turnaround are considered to be attributes associated with productivity levels of systems developers. Assuming an accurate measurement tool is in use, the attributes can be varied to measure the impact on productivity. Vary the response time and measure the results. If the measurement tool is capable of tracking this type of variable, it can be considered an effective management tool.

The ADC holds responsibility for technology transfer to the remainder of the systems development staff. For the organization to be successful, the MIS executive must jealously guard the consultative role of the ADC staff. There will be tremendous pressure to include the experts in the actual development process. If the ADC is co-opted in this manner, it will cease to exist. The central idea is to pool the best talent and share it with the entire inventory of applications to be developed. Should this talent be utilized for development itself, the concept of sharing is lost.

Rather than identify ADC representatives as part of a project team, they should be cast in a liaison role. The role of the ADC liaison is to provide technical support in the use of the products and to enforce standards. This role (technology transfer) requires training, assistance, and constant investigation of new methods, tools, and techniques. New products are being introduced daily. To remain current, continuous investigation is a must.

The following has been included as part of the responsibilities of the ADC but is highly dependent on the structure of each organization. To provide the full range of assistance in systems development, the ADC can play a major role in data administration and test data support. Data administration is not to be confused with data base management. The data administration function is involved with the design and tuning of the logical view of data. The physical organization of the data and the navigation of the data base to retrieve data should be left to the technicians populating the DBMS world. The ADC staff plays the role of promoting the concept of data driven design through the use of a dynamic, interactive data dictionary. All future systems should not be viewed as a series of processes that collect, store, manipulate, and display data. Rather, the perspective must be that a single source of non-redundant, related data is available to support any number of processes. The staff of the ADC is available to provide the most effective view of the data to the end user to support a particular process.

The role of data administration can be extended to include a central support for all test data. From the dawn of time, MIS professionals have created test data for ad hoc purposes. With the completion of the project, the test data is released and lost forever. The next project team begins anew to create data for a specific purpose, and the next, and the next. The ADC can be used as a repository for all test data. New project teams can view the growing inventory of test cases to extract suitable data and deposit additional cases to the inventory. The most effective mechanism is to have the ADC as custodians of a series of routines that can instantly review the production master files, guided by a series of parameters provided by the project team. The test data is a microcosm of the live data base, tailored for specific functions. Effective regression testing can easily be performed using this procedure.

The final responsibility of the ADC staff involves coordinating the functions of the ADC with all other MIS groups. The following interactions will support the previously mentioned responsibilities:

a. Technical Services - Installing fourth generation products and performance tuning to insure optimum efficiency.

b. Computer Operations - Negotiating service level agreements and monitoring actual performance.

c. Systems Management - Coordinating the use of project control tracking data to integrate with the measurement of productivity trends.

d. Data Base Management - Orchestrating the effective integration of the logical data views with the physical structure of the data base.

The ADC should not have data security functions. MIS management must assign this responsibility elsewhere. If security is left to fend for itself, the ADC could be a vulnerable area for misuse of data. The ADC has the tools for rapid consolidation and dissemination of data and the data administration role. Together, these two assets could provide the base for significant security risks. It would be well advised to appoint a data security administrator who has no organizational bond to the ADC.

Functions and Organization

The extent to which functions can be supported within an ADC will be heavily dependent on the size of the organization it serves. The larger the organization the more intensive the support of the functions. But regardless of the size, the functions discussed in this presentation should be supported in some fashion. It must be understood that a number of functions can be performed by the same individual in a small MIS group. The size of an organization should not be used as an excuse to overlook any functions; smaller groups will only need to adjust the level and intensity of the service.

Two primary functions of the ADC must be given the highest attention. The reason for creating the ADC was to improve productivity. Thus, the main functions will be to pursue research and development of productivity tools and techniques and to consult and educate systems developers in the use of the products. The tasks associated with these functions are as follows:

a. Identify and maintain an awareness of the development problems to be solved.

b. Design selection criteria and evaluation techniques for new products and methodologies.

c. Identify new hardware, software, methods and techniques; evaluate and test those products.

d. Develop financial justification for selected products and pursue the approval process.

e. Produce and maintain product usage guides and introduce products for aiding ease of use.

f. Create an educational model and initiate education for the systems staff.

g. Define a pilot project, serve as an integral part of the project, and evaluate the results.

h. Above all else, promote a culture of high productivity.

To promote a culture of high productivity, the ADC staff will need to practice sales and marketing techniques. The professionals in systems development will not rush to the ADC for guidance and knowledge. The ADC staff must market its product to the systems staff and sell the concept of greater productivity. The active support of the senior MIS executive will be urgently needed in the early stages to ease and strengthen the sales potential of the ADC personnel.

The additional functions of the ADC are important but secondary to the two primary functions. Those remaining include process management, quality assurance, and data administration. Earlier, the proposition was made that the responsibility of data administration could be enlarged to include custodial responsibilities for all test data. To effectively perform the secondary functions, the tasks to be accomplished are:

Process Management

a. Perform a study, select and implement a systems development methodology.

b. Define and perform the function of Project Control Administration.

c. Integrate all existing productivity tools into the development methodology.

d. Install and operate an automated tracking and monitoring system for productivity measurement.

Quality Assurance

a. Review and improve quality standards to strive for perfection in the development of new systems.

b. Instruct in the use of and assure adherence to the quality practices of the development methodology.

c. Conduct project walk-throughs on request and emphasize the three major objectives of quality assurance. The system must be correct, reliable, and maintainable.

d. Periodically analyze project control reports to identify problems and take corrective action.

Data Administration

a. Promote the culture and understanding of data directed development.

b. Develop and maintain all common data definitions in a central dictionary.

c. Administer a central test data base for all applications.

d. Develop a mechanism to refresh the test data base with extracts of representative production data for all applications.

The functions of the ADC can be as many or as few as the individual organization can support. The limitations on the functions performed are primarily the result of the size of the systems and programming staff. The norm is to provide one ADC staff member for every ten MIS professionals. A single individual could perform all of the functions listed above, but it is doubtful that it would be a success. Adapt the functions to the size of the organization and do not risk failure by attempting too great a task.

An ADC will function in an MIS environment with ten or more professionals, but the chances of success are greater if the staff size is twenty and above. For organizations with staffs of less than ten, the management must provide the productivity tools and encourage the existence of an informal ADC. Open communication is an advantage of a small staff. Everyone is aware of the talents of their peers and the most talented are generally regarded as leaders. In addition, all are aware of the tasks that others are performing. In this environnment, close cooperation and open communication can substitute for a formal developmenmt center. The manager of systems and programming would assume many of the formal ADC functions as part of his/her job description.

The minimum staff should consist of a technical consultant and a technical analyst. The consultant should be selected based upon project management ability and interpersonal skills. The primary requisite for the analyst should be technical skills and peer recognition as a leader in the technical aspects of development work. The staffing norm is ten percent of the total MIS professionals, therefore there should be a consultant and an analyst for every twenty systems analysts/programmers. Ideally, the full complement of ADC staff would also include a manager, a data administrator, a project control specialist, a quality assurance analyst and clerical support. This level of staffing can only occur in the larger MIS environments, but it is important to reiterate that the functions can be performed in any environment. Do not use the lack of staffing as an excuse for not creating an ADC; the concept will work regardless of the size of the organization.

Justification and Summary

The tools available to systems developers will reduce by half the work effort to develop new systems. In addition, a system developed in a fourth generation language environment will require one tenth the work effort to maintain as a system developed with a third generation language (COBOL). The net effect on the amount of work than can be accomplished is dramatic. The improvements in programming maintainance will have the more significant long term impact. All software packages developed in languages such as COBOL will soon be obsolete. It is not cost effective to install a software package to save time and money if the end result is to expend ten times the required effort to maintain the system.

Currently, the amount of work expended on maintaining a system is sixty percent of the total effort. If the maintainance effort can be reduced by ninety percent, the savings generated by installing a software package is lost. It would be more economical to use a fourth generation language to develop the system internally or, better yet, buy a fourth generation software package. The net result will be to double the amount of output created by the systems and programming staff. It is not enough to install fourth generation tools. A dramatic increase in productivity is dependent on the correct and consistent use of the new tools. The Application Development Center is the vehicle that will insure success and transport the MIS staff to a more productive future.

COLLEGE INFORMATION MANAGEMENT SYSTEM
THE DESIGN AND IMPLEMENTATION OF A COMPLETELY INTEGRATED OFFICE AUTOMATION AND STUDENT INFORMATION SYTEM

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The College Information Management System (CIMS) is a unique, comprehensive, integrated office automation and student data system, operating in a dual environment with an office minicomputer and the University's central administrative computer. CIMS has revitalized the College advising process and allowed for much more efficient and effective tracking of over 6200 students. CIMS has benefited College students by providing advisors with more timely and accurate information, by supporting better tracking of student progress, and by providing extensive information on student behavior for the support of long range planning. It includes eight subsystems implemented in stages from June 1985 through Spring 1987.

COLLEGE INFORMATION MANAGEMENT SYSTEM

The College Information Management System (or CIMS) is a comprehensive, integrated office automation and student data system, which operates in a dual environment with an office minicomputer and the University's central administrative computer. To our knowledge, it is the only one of its kind with a number of unique characteristics. I would like first to present the context for the planning and development of CIMS and then describe the design and development process. I will then describe the system itself and how it works and conclude with a discussion of what we learned from the development of CIMS and what we plan for the future.

THE CONTEXT

Like many other large educational institutions, the University of Pennsylvania has centralized many of its student service functions and uses centralized student data systems to help manage them. Those systems were originally designed to support only central, operational needs in a batch environment, and they are now so archaic that they do not even do that very well. They certainly do not support the various University demands for strategic information for planning and decision making nor do they really support any of the individual school needs for operational or information support. It is also the case that each separate school has unique, local needs that could never be fulfilled by an exclusively central system.

The College of Arts and Sciences is the largest undergraduate unit at Penn, serving approximately 6200 students, with 500 standing faculty, 250 non-standing faculty and 400 graduate teaching assistants. While the Registrar actually processes registration and drop/add, the College Office advises the students on registration, collects and verifies forms and forwards them to the Registrar's Office, tracks students throughout their academic career, and certifies all College students for graduation. It also coordinates all of the advising and recording keeping efforts performed by the 28 academic departments and 14 academic programs in the School.

Considering the number of students being served, the College advising staff is quite small, with approximately 13 FTE professional/faculty staff and 15 clerical and support staff performing a wide variety of functions.

For several years the College Office has had to deal with a very difficult and sometimes impossible situation involving the management of information. For example, every year the College staff filed approximately 15,000 transcripts, processed 20,000 drop/add forms, oriented and advised 1400 freshmen, graduated 1400 seniors, sent and received 15,000 letters, and advised students in approximately 20,000 interviews. With so many students to serve in so many different ways with so small a staff, automated support was essential to the provision of quality service, but the central systems were not appropriate or useful. Thus, over the years since 1981, my office designed a number of small, automated systems to deal with individual tasks. While those systems worked well, by 1984 it was clear that they were quickly becoming small bandaids on a very large and fast-spreading wound.

In November 1984, I received approval from the Provost to develop a completely automated, integrated office automation and student data system. Provost Ehrlich was very concerned about "shrinking the psychological size of the University" and thought that this project might be a good pilot in attempting to do just that. We spent some time planning the project and the design and development process and began the project officially in January 1985.

PROJECT DESIGN AND DEVELOPMENT PROCESS

Expectations: We entered into this project with a number of expectations about its outcome and the changes which would take place as a result of its implementation. Our primary goal was to store all student information electronically. The practice in the College Office had been to store all information on a particular student in a manilla folder. That practice resulted in an enormous amount of filing, retrieving, and sometimes temporarily misplaced folders. If we could store all student information electronically, advisors and administrative staff would be able to reduce the amount of time wasted on handling folders and increase the amount of time available for quality service to students.

Since the two main functions of the College support staff were record keeping and word processing, we assumed that a good office automation system would greatly enhance the productivity of those staff members. We hoped that we might also be able to include direct update of data to the central systems, although we were pessimistic about the acceptance of such an idea by the other offices on campus.

Because of the older, centralized information systems, the method used to transmit information to those systems, and the limited, bi-weekly central updates to the system, academic advisors were often advising students with obsolete information. If we could include local update capabilities in our system, more timely information would always be available to advisors and staff alike.

Finally, we realized that there might be some resistance to the installation of a completely automated system not only because individuals might be afraid of using a computer, but also because the new system would require the redefinition of most jobs in the office. However, we hoped that with the proper training and support, the advantages of the new system would soon transform reluctance into excitement and satisfaction.

Happily, virtually all of our expectations were realized. In fact, we were able to include direct update to the central files in a number of areas. We realized this goal because the offices with whom we were working began to see how our project could reduce duplication of effort and in fact decrease their own workload.

CIMS Development Approach and Team Structure: At the outset of our project, we decided that we would not use the traditional system development approach to application design. Up until that time with any application, no matter who the user was, University Management Information

Systems (UMIS) performed the needs analysis, the functional and detailed design, produced the programming specifications, coded the system, tested it and produced documentation with limited user input and no user participation in the process. The inevitable result was a system that was not anywhere near as useful to the user as it could have been with the proper participation. The structure of our design approach and team was new certainly to Penn and had an enormous impact on the outcome of the project.

The CIMS team consisted of three different groups all working closely together: SAS Planning and Analysis, UMIS, and the College Office. I was the overall project director and was responsible for the coordination of effort for all three groups and all phases of the project. It was the first time that the leadership for any UMIS application development came from outside UMIS. There was also a UMIS project manager and a project coordinator for the College Office group.

My office performed the needs analysis and then worked together with UMIS on the functional design, which I then presented to the appropriate College Office staff members for comment and approval. The UMIS staff and my systems analyst then proceeded with the detailed design and programming specifications. After College approval of that document, UMIS programmers coded the system and performed some initial testing. My systems analyst and the College project coordinator then performed extensive testing, and, after problem corrections by UMIS, performed training and implementation. My systems analyst and the college coordinator composed all the user documentation and developed a new Office Procedures Manual to help the College staff with their new responsibilities.

In the initial design of CIMS, we were able to divide the system into subsystems and then proceed as described above for each of those subsystems. In that way, we were able to install the subsystems in a phased manner. The phased installation turned out to be a very good idea in a number of ways. First, it allowed us to see some results of our efforts relatively soon after the beginning of the project. Second, it allowed the College staff to ease into the use of the computer with the training taking place for each new subsystem helping to reinforce previous learning. About half of the subsystems were implemented during the first year of the project. During the second year, we implemented the second half and worked on fine tuning both sets of subsystems.

Despite complications and delays that frustrated all the members of the team, the result has been a very useful system. The staff have found it easy to use and helpful in carrying out their daily responsibilities. As time goes by, they find more and more ways to take advantage of its capabilities and are thus able to increase the amount and quality of service they offer. It is also the case that a number of the other schools at Penn have seen our system and requested it for their own use.

THE CIMS SYSTEM

CIMS consists of two major components, the office component and the data management component, which are completely integrated. The office component resides on an IBM System/36 minicomputer located in the College Office, using IBM software packages for word processing, electronic messaging and ad hoc query. Each staff member has a terminal or PC attached to the S/36 with a uniform menu offering them the option of working on the office or data management portion of the system. The System 36 acts as a 30-port 3270 control unit, thus giving each workstation high speed access to the University administrative computer. Since the S/36 is a relatively user-friendly machine, we were able to train an existing staff member with no computer experience to act as the System Operator.

The data management component resides on our mainframe IBM 3081 administrative computer. It is a collection of eight subsystems implemented in ADABAS, coded in Natural, and running under CICS. CIMS data, which are organized around student identification number, include both central University data and local College data. I would like to give you a general sense of each of these eight subsytems with a brief description of their special features.

The Student Information Subsystem was our first implementation in June 1985. In includes twelve screens displaying biodemographic and academic data on our students; such as admissions information, home and local address, parent and sibling information, varsity sports and financial aid information. Two of the special features are the "student snapshot screen" for advisors to get a quick sense of the student and his/her status just before an interview and the cumulative history screens which give the advisors a sense of the student's activity with the office. The history screens include correspondence history, a history of academic actions, a history of petitions and requests, and a history of academic probation.

The Interview Notes Subsystem, also installed in June 1985, consists of three screens and allows the advisors to take notes on the interview with the student and also to review past notes in reverse chronological order beginning with any date. The subsystem includes a checklist of keyword topics for quick notes as well as later analysis. One advantage of the topics checklist is that it gives advisors a chance to analyze their "collective experience" over time and to identify any chronic or emergent topics of concern among their student clients.

The Transcript Subsystem allows for online viewing of the transcript as well as enrollment in current courses. It allows the College staff to electronically update academic actions such as Dean's List or Leave of Absence or Study Abroad. Staff members can also print local, unoffical copies of the transcript. The transcript subsystem was one of the most complex and most useful in taking advantage of ADABAS to improve on the obsolescence of our current centralized transcript system. Thus we are able to make changes and make decisions based on those changes sometimes up to several weeks before those changes are recognized by the centralized system.

Two of the transcript screens fully reproduce the University's online transcript but with the added feature of a temporary grade column along side the official grade. The registrar does batch upload of grade changes from paper forms only twice a month. Thus to provide more timely information to advisors, College staff key in the grade change to the CIMS temporary grade column before sending the form to the Registrar. The temporary grade is then visible to advisors and initiates a recalculation of the relevent term and cumulative averages, which are then marked with an asterisk to show that they include temporary grades. When the grade becomes official, the temporary grade is cleared and the asterisk is eleminated from the averages. This temporary grade feature has revolutionized the process by which College staff clear 1200 seniors for graduation only one week after finals.

The Forms Processing Subsystem was also incredibly complex to design and implement but wonderfully useful in cutting down on duplication of effort. It allows the College staff to communicate electronically on eight forms what they used to have to do with fifteen forms filled out in quadruplicate and sent to three different offices. These include forms for academic actions, student petitions, application for major/minor, application for foreign study, application for submatriculation into Penn's graduate schools, and request for adjustment of the student's bill. Some of the forms serve to capture information for the College's local use only, but others, such as academic actions and major/minor application, actually transfer data electronically to the central files. The subsystem's most important feature is its suspense file for actions that will take place as of an effective date at some point in the future. Such a suspense file exists nowhere on our current University systems.

Each screen in Forms Processing has a common format for processing student forms. The top part identifies the student, the middle part describes the petition, and the final part reports the decision on that petition. Each screen makes use of required fields to ensure that all forms are filled out completely.

The Graduation Tracking Subsystem is enormously helpful in allowing the graduate auditor to correspond intensively with approximately 1400 seniors each year, to check their records thoroughly and to clear them for graduation only days after final grades are recorded. It has three data screens and 22 prewritten reports.

The screens act as an organizing checklist for tracking each student through graduation mileposts. These include completion of an application to graduate, a course requirements worksheet, certification of major requirements, and completion of outstanding courses.

The twenty-two reports are selected from a menu and run as needed throughout the six-month-long tracking process. The reports perform selections of basic tracking information keyed into the online screens. Particularly useful are those reports which identify students with problems relating to their graduation candidacy. These give the College graduation auditor time to intervene and have a student correct the deficiency.

One of the reports generates a final graduation list which is used as camera ready copy for printing the graduation program. The final report electronically updates the permanent record of each successful graduate - noting the date of graduation and the degree received with all relevent honors earned. Both of these processes had formerly been done manually.

The Correspondence Subsystem involves the real integration of the office systems on the System/36 with the data management system on the mainframe. It is designed to capture essential summary information about every piece of correspondence either received in the College Office or sent from the Office. It includes four screens which process all incoming and outgoing mail in the College.

Each day a staff member scans every letter received and enters onto the logging screen: the student i.d., information on TO whom the letter was sent, FROM whom it was sent, a KEYWORD summarizing the letter's content, and to whom the letter was ROUTED for handling and response. A similar logging screen captures this information for outgoing mail. This screen is a specially designed addition to the System/36 word processing package. We interrupt word processing at the end of every edit session and transfer the user to the Correspondence Sent log screen. This semi-automatic process ensures that the user does not have to remember to log outgoing correspondence. If the outgoing letter is a mass mailing, the logging program (written in S/36 COBOL) will create one log record for each name in the mass mail data file. The user, however, fills out the log screen only once. Information from both logging processes is combined and uploaded to the student's record on the mainframe each night.

The summary data are then available to staff members in the form of a Correspondence History Screen in the Student Information Subsystem. By scrolling this screen, a staff member can view summaries of all correspondence relating to a particular student sent or received over that student's entire career at Penn. Further, should the staff member wish to locate a specific letter, the summary screen indicates the location of all correspondence - whether paper or disk file versions.

The Calendar Subsystem is the only one not yet implemented in CIMS. We tried to use IBM Personal Manager on the mainframe with a custom written interface to CIMS so that appointment information could be recorded on each student's record. Personal Manager turned out to be less than ideal for the task. We now plan to use the System/36 Personal Services with a similar interface. That system will allow the appointment secretary to schedule individual and group appointments of advisors. This is currently being done manually on large columnar sheets. The automated calendar will also allow the appointment secretary to note whether or not a student actually came for the interview.

The Query Subsystem uses Information Builders, Inc. FOCUS 4GL and its menu-driven user-friendly front end, TABLETALK as a query tool to allow ad hoc query of the CIMS system by selected staff members of the College Office. These are implemented with IBI's FOCUS-ADABAS interface facility. TABLETALK requires no computer sophistication on the part of the user and allows him/her to produce reports, either on screen or on the system printer.

One of our primary goals in the CIMS design was to make data easily accessible to all College staff members for the production of ad hoc as well as prewritten reports. Such a capability would allow the College staff to produce labels and at least simple reports without having to depend on the expertise of the Office of Planning. In addition, we hoped that once the staff started using CIMS to imput and review data on-line, they would begin to generate ideas of their own concerning the analytic use of those data. That phenomenon has occurred. Our biggest concern now is proper training and supervision. TABLETALK is a very powerful tool, but if the user is not clear on the data elements and logic involved, s/he could draw incorrect conclusions from his/her own reports. Thus we have tried to train the selected users very carefully in analytic techniques as well as in TABLETALK, and we continue to work with them as they produce and use their initial reports.

CIMS Highlights: I have already discussed the major features of CIMS: the on-line access to information formerly stored in only paper files, the combination of both local and central data in the system, the distributed update capability, and the powerful query tools. There are a few other very important points about the system which I should mention here. CIMS contains a context sensitive on-line help facility, an extensive security system and an extensive system of error reporting throughout the system in order to maintain the accuracy of data. We also designed a special table maintenance facility which allows users to control changes to the CIMS tables. In addition, the design and development of CIMS stimulated a clarification and codification of College office procedures as well as a redefinition of virtually every job in the office. That process has increased individual efficiency and effectiveness and allowed for a much easier transition when there is staff turnover in the office.

LESSONS LEARNED FROM CIMS

University "Firsts": This project represented for the University a whole new era in administrative computing - an era when the level of technology and the sophistication of the user demanded an entirely different system and a different kind of relationship between the system users and the central data processing unit. Thus, the most significant "first" of CIMS besides CIMS itself was the formation and constitution of the system development team.

Ours was the first system with a project director who was outside UMIS. Ours was the first system in which a group of sophisticated users participated so closely in the general and detailed design, the testing, the training and implementation, and development of user documentation. This is, I believe, the way of the future. Since the beginning of our project, the University has initiated the development of new central student information systems, personnel/payroll systems and facilities planning systems. For all those projects, the director is external to UMIS and the users are closely involved in the design. In analyzing the varying success of those projects, it is clear that those most closely involving users are the more successful projects. Our project would never have succeeded if the team had been configured in any other way.

CIMS was also the first University application using ADABAS with virtually all the coding done in Natural. That meant that we all had to go through an intense learn process in the CIMS project but that we could also take advantage of the sophistication of ADABAS to improve the utility of our system.

Another feature of our team which is not obvious was my intimate knowledge of the operations of the College Office, for I had run the College Office before taking over planning and administrative information systems. The fact that I understood so well the functions to be performed as well as the capabilities of the system to perform them helped to move the project along despite the complexities.

Our system was the first and remains the only application which incorporates both the host system and a departmental system in a completely integrated office automation and data processing system. So far, we have seen only advantages to such a system. The System/36 works very well as an office system and communicates well with our IBM mainframe so that we have a fairly user-friendly environment which promises to get easier and easier as time goes on.

Our system was the first application with distributed update capabilities. All of the new systems being designed now will include those capabilities, and our experience in CIMS is helping us to shape our future systems. In fact, as we design and implement those new systems, we will have the opportunity to completely change the nature of our administrative structure so that our services are much more efficient and effective.

With so many firsts, it was inevitable that we would make some mistakes, and we did. The biggest mistake, I think, was to be unrealistic about the implementation dates. While there may have been some good excuses for being unrealistic, the results were very damaging to the project. Once the deadline was past, many of the members of the team began to feel very negative about CIMS in that it was a source of guilt, that it introduced some sense of failure, and that it was interfering with other projects that had been planned. Thus, I have learned to plan the time frame for any project realistically no matter what the political pressures.

CIMS Costs: The hardware and System/36 software as well as a small amount of site preparation cost about $225,000. Personnel costs were at least $175,000, but most of that was for University personnel. Thus the cost was in what else they might have done instead of CIMS. There is no question that the benefit was worth the cost to the School of Arts and Sciences. Indeed, the cost was probably worth the experience and the CIMS model to UMIS and to the University as a whole.

CIMS Benefits: There are many benefits to CIMS, and they exist on three different levels. There is no question that there is increased quality in advising and record-keeping because more accurate and timely information is available to any College staff member at all times. Advisors can provide more quality information to their students and can spend more time advising and less time looking for the appropriate information. It is also the case that now that the College staff members - that is, the individuals responsible for the welfare of our students - enter the data directly into the system, there is a greater chance for accuracy in the records and the staff feel that they have more control over the University bureaucracy. These particular benefits are quite visible to students on a day-to-day basis. Early on in the installation process, one Assistant Dean who had remained quite sceptical, confessed that it was wonderful to be able to correct a student's record before his/her eyes.

Another great benefit of CIMS is not so readily visible to students, and yet is probably more important to them in the long run. That is the ability to perform much better tracking on students as they proceed through their program. Too often in the past, the limitations of manual or partially automated systems made it impossible to perform all the tracking necessary. Thus, we did what was most crucial but not many other things that were also extremely important. We checked as best we could on students who might be in academic difficulty, but we never had the time to send out fellowship, award or graduate study information to our best students. Now we will be able to do that and much, much more. In addition, while the College as a whole will perform the major tasks, any individual advisor will be able to perform an ad hoc query and send a letter or information to any group of students he or she likes. That Assistant Dean will use query, for example, to ask for all his/her students who have not come in for the past two months and are taking calculus, will send the names and addresses to the System/36, and then send them all individualized letters to come in for a visit. In addition, the notation of that letter will go on the student's electronic record.

The most significant benefit arising out of CIMS will never actually be evident to the students. That is that CIMS provides us with extensive and detailed information that we have desperately needed but never had before. We will use that information to provide high quality support for our short term decision making as well as our long range planning. The evidence of that benefit has already been made clear to the Undergraduate Committee on Education in its efforts to create a new distributional requirement system. Our Dean has found this information invaluable in his efforts to enhance the College experience at Penn.

THE FUTURE FOR CIMS

We have already extended the benefits of CIMS to our academic advisors in the residences and we plan to offer some of the CIMS services to the undergraduate advisors in each of the academic departments. As more and more advisors join the system on line, we have less and less need to send them paper. They will no longer need hard copies of the transcript. They will be able to approve a major application at the terminal on their desk. This system will help us to encourage increased faculty involvement in advising. In fact, we have seriously considered the idea of putting the rules and regulations on line so that they can be easily consulted by any advisor.

The most important future development for CIMS is the implementation by the University of new student systems. The University has already installed a new financial aid package. We are now in the process of modifying and installing a ADABAS Student Records System (SRS) package by Information Associates. SRS will include on-line course inventory, course registration, and drop/add functions, and will be an enormous improvement over our current central systems. However, it does not include many of the most important features of CIMS. Thus, CIMS will be modified as the new system is installed and will continue to be an enhancement for many years to come, not only for the College but also for several of the other Schools at Penn.

Improving Managerial Productivity
Using Microcomputers

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ABSTRACT

Prior to 1986 little had been done to apply computer technology to the improvement of managerial productivity. The development of an integrated information asset accessible from low-cost, desk-top microcomputers via user-friendly software encouraged the development of managerial support applications at Baldwin-Wallace College.

After a year and a half tangible results include dramatic increases in both short-term and long-term planning and increased integration of planning among administrative units. While use of microcomputer-based managerial support systems is not without problems and concerns, the early results have encouraged us to expand efforts in the coming year.

The Challenge

Rapid growth in the student body, expectations of declining enrollments during the 1990's, the instituting of a merit compensation system, and an impending accreditation visit were among the factors that served to stimulate an administrative desire to increase managerial productivity. The existence of an integrated, computer-based administrative records system, and the availability of inexpensive yet powerful desk-top computing coupled with user-friendly software seemed to provide the resources needed to help managers be more productive. The challenge to the Information and Computer Services department was to provide the leadership, training and support necessary to realize the potential of hardware, software, and managerial enthusiasm in terms of increased productivity.

Background

Baldwin-Wallace College is a private, co-educational, liberal arts college founded in 1845 and located fourteen miles south of Cleveland, Ohio, in the town of Berea. The College has a full-time undergraduate enrollment of approximately 2200, with 1350 part-time undergraduates and 650 graduate students. There are 135 full-time and 140 part-time faculty.

The college's computer facilities include two Prime 750 superminicomputers networked for administrative processing, and a Prime 2655 used for academic processing. The two administrative machines host a data structure that, while organized along functional lines, allows for easy intra-office sharing of data. By the time the managerial productivity project was begun virtually all clerical record keeping functions had been implemented on the administrative network.

Prior to the management productivity project the administrative use of microcomputers was limited to two or three applications where software was purchased from third-party vendors for specific functions. The current mix of administrative microcomputers includes 18 IBM PC/XT's or PC/AT's and 15 of the newer IBM PS/2 model 30's. (While 33 microcomputers may seem to be a rather small number, remember that this represents a potential productivity enhancement for approximately two thirds of the management team of Baldwin-Wallace.)

The administrative computer staff is comprised of four COBOL programmers, four production assistants, two administrators, and a secretary. There are four student employees to support administrative work. The department is organized to provide maximum flexibility. Work is organized into team projects within an environment that is personally supportive and frequently provides opportunities for professional development.

An important contribution of the Information and Computer Services staff is expertise in managerial and analytical techniques. The Director of Information and Computer Services has an MBA degree; several programmers and production assistants have undergraduate degrees in Business or business-related fields. A key element in hiring decisions is the ability to teach and convey technical information to a non-technical person in a clear, non-threatening manner. As a result of hiring policies and a 95+% on-time request completion rate there exists excellent working relations between Information and Computer Services and the managers of client offices.

Many of our administrative managers have come from the faculty; few have had either an education in management or experience in the business world. The lack of knowledge in such topics as statistics, linear programming, regression analysis, and scenario modeling was a hurdle recognized at the start of the project. Fortunately, managers recognized these shortcomings and were, for the most part, eager to remedy the situation.

The Process

Laying the Groundwork

The work directly with managers began in 1986, but the roots of the managerial productivity project reach back to the early 1980's. Changes in technology and management were manifested in an integrated information structure, greater involvement of client offices in information planning, and improved working relations between the Computer Center and the rest of the College administration.

While the immediate goal of early changes was to improve service to students, the long range goal was to develop both the technical and the organizational climate in which Information and Computer Services could facilitate improved managerial productivity.

To the good fortune of Baldwin-Wallace, as we were developing the internal environment for change, the computer industry was developing powerful desk-top computers and user-friendly software.

Before working with individual managers six key elements of the project were identified: securing the support of the College's officers, hardware selection, software selection, training, data transfer, and continued long-term support of managers. Probably the easiest task was securing the enthusiastic support of the College's officers. Their support was reflected in commitments of funds for hardware and software, support of policy recommendations, and most importantly as role models. Several vice-presidents were among the first to schedule training for themselves and they then encouraged their immediate subordinates to take advantage of the opportunities to become more productive. Establishing policies for the standardization of hardware and software, the centralization of purchasing authority, the necessity of documentation and backup procedures, and recognition that central processing and distributed management applications could, indeed must, coexist, created a firm foundation upon which the project could be built.

Decisions on hardware and software were predicated on support concerns. Baldwin-Wallace elected to purchase IBM microcomputers to maximize maintenance options and to simplify software support. (Experience had shown that "MS DOS compatible" often meant that substantial time was required to make software operational and that documentation failed to identify all variations that might be encountered on non-IBM hardware.) IBM simplified the decision to forsake the less expensive clones by offering an aggressive discounting program.

Software was needed to do word processing, spreadsheets, data storage and retrieval, graphics, statistical analysis and communications. With a host of software packages available to do each task the primary selection concern was which software was the simplest to use and what was the quality of available training materials. Initially we had hoped that a single vendor for each type of software would be identified, and ideally there would be an integrated software system which would do most, or all, of the necessary tasks. Due to the variety of needs and prior client experience levels it was necessary to provide a choice of word processing packages (WordMarc and PFS:Write) and a choice of communications products (LinkMarc and Kermit). Lotus 1-2-3 was adopted as the standard for spreadsheets and graphics. The Arthur Anderson video tapes have been extremely useful in the instruction of Lotus 1-2-3. All client developed database applications use PFS:File while some of the more complex applications developed by the Information and Computer Services staff use DBase III+.

Before the project moved to working with managers the College's officers affirmed a policy that managers would have inquiry access to all appropriate items of the centralized database but that it would not be acceptable for an office to attempt to use a microcomputer to replace centralized storage of information used by more than one functional area. The cost of these policies is to increase the work of extracting and transferring data; the benefits are that a consistent institutional picture is available to all managers and the gains in data integrity accruing from a centrally administered system are maintained.

Training

Far and away the largest task in the managerial productivity project was, and continues to be, training. We moved simultaneously on three fronts. First, we began to offer our own staff (i.e. Information and Computer Services) training in microcomputer software. Some of the staff had limited experience with microcomputers, some had none at all. Microcomputers like those that would be provided to managers were installed in every Computer Center office. Those software packages which would be used in the project were provided along with the hardware. Staff members were encouraged to attend both credit-bearing classes offered at the College and outside seminars. A goal at Baldwin-Wallace is to provide each professional employee several hours per week to be used for professional development; during 1986 and 1987 the most common professional development activity in Information & Computer Services was familiarization with microcomputing. Several staff members were interested in having microcomputers in their homes; they were loaned machines and software for several months.

All members of the Information and Computer Services staff were included in the training. This was done in the belief that each staff member would be involved in the support effort. The philosophy of team projects requires that there be a general understanding of problems and solutions by all team members as well as detailed knowledge by specialists. Hiring requirements were expanded for most positions to include microcomputer experience.

Second, we began to train our staff in the simple hardware maintenance of microcomputers; that is, replacing boards, installing printers, etc. One of our staff became the chief problem solver and trainer. When a problem with a microcomputer occurred, that person would read manuals, experiment, make vendor contacts and then when the problem was solved would gather an impromptu "class" of staff and share the experience gained. The new "microcomputer specialist" had no prior training in microcomputers but had a desire to learn and the tenacity to stick with difficult problems.

Third, we began to install microcomputers in administrative departments. The first ones were installed on carts, so that they could be moved from office to office. The software provided at this stage consisted of some demonstrations that basically ran by themselves and a few very user-friendly applications packages. The intent at this point was not to do any content instruction but to establish acceptance of a new tool. (We wouldn't have been too surprised if a little game playing was done in the early days, nor would we have been unhappy.)

At this point we discovered that although most managers didn't have microcomputer skills, most departments had at least one employee who did. Virtually every department had employees who had ideas for computer use, usually simple list keeping or forms development. For these simple tasks PFS:Write and PFS:File were ideal; they required no formal support, the documentation was easy to read, work could easily be changed, and simple results were normally produced in the first hour or two. If there was a downside to this it was that clients developed the bad habit of "build a quick little application now, and worry about documentation later".

Once our staff training was underway and a few microcomputers were installed in administrative offices, the most sensitive part of the program was undertaken: the training of the college managers. Our experience was that the College vice-presidents and department managers were cautious of the new equipment and sometimes were apprehensive about being "students" again. A particularly supportive environment was needed.

A program of training was begun with several important components. The training was done by the Director of Information and Computer Services, a peer of the managers involved, and highly respected by them for his expertise and teaching skills. The training was done in the Computer Center microcomputer lab during a break in the school year, so that no traditional students would be accidental observers. The microcomputer lab was closed to all others during these sessions. Groups were no larger than five and were extremely informal, gathering around a microcomputer or two for observation and some hands-on experience. Five sessions were held. The first three sessions were an introduction to LOTUS 1-2-3, with emphasis on the nature of a spreadsheet and its uses. The last two sessions were the actual development of a spreadsheet reflecting long term trends in faculty departmental workloads. Special emphasis was on the analysis of the spreadsheet involved, more than on the clerical entry of the data, since our objective was to demonstrate planning and analysis tools.

We learned several important lessons from the first set of training sessions. One, get managers to put their hands on the keyboard and type. Have them learn that it's okay to make mistakes: the computers will not blow up and no little sirens are going to be sounded. Two, the training worked best when managers were solving their problems, not ours. We had them bring a problem that they felt was amenable to solution with a spreadsheet. Some of the problems were not amenable to a spreadsheet type solution - this too is a valuable lesson to learn. Three, managers are handicapped in that they do not generally have good keyboarding skills. This is a hurdle to overcome. Those software features that reduce keyboarding will be received enthusiastically.

Once managers had learned to use Lotus 1-2-3 we were well on our way. Using spreadsheets as the organizing and computational tool, managers were able to begin building and refining models. This required the organizing and writing down of many of the inter-relationships which managers had learned through years of experience. The ability to test many scenarios and tune decision values to obtain optimal results was exciting; previously the computational or programming requirements to do such analysis were prohibitive.

The quick successes with spreadsheets provided the incentive to explore other software. Communications software provided an avenue for the transfer of data from the mainframes to individual microcomputers. Word processing was soon coupled with graphics to generate more readable reports.

Support Issues

Once the first groups of managers had completed their orientation to microcomputing it was necessary to develop a more extensive hardware resource. The movable computers were supplemented by the installation of systems in the managers' offices. Experience during the training sessions had shown that the less diskette handling the better, so systems were installed with a hard disk. Also, managers were much more interested in solving problems than in learning the intricacies of DOS. A menu system was installed which eliminated the manager's need to learn anything other than the applications they would use.

Extensive one-on-one support from the Computer Center staff was necessary during this time. When a newly computer literate manager needed help, our staff responded, spending whatever time was necessary to teach the skills required. It quickly became obvious that more long term support would be necessary than had originally been anticipated. We began to search for a full-time microcomputer expert for our staff.

To minimize the trauma that would surely result the first time a hard disk drive crashed, a two stage backup procedure was implemented. Clients were cautioned to do regular backups of the hard disks to diskettes. A second backup of hard disks is performed by Information & Computer Services on a weekly basis. A Bernoulli disk system has been placed on a cart and an interface card has been installed in each hard drive system. The responsibility for the weekly backup has been assigned to a student assistant.

Some of our managers became very comfortable with microcomputers, using them on a daily basis. Others quickly transferred the responsibility for microcomputer use to others in their departments. They continued to use the output from the microcomputers as the basis for analysis and planning, however.

Outcomes

A year and a half later, the preliminary results have been encouraging, but sometimes unexpected. More technical support from Computer Center staff has been needed than we had thought. Requests to transfer subsets of data from the centralized data base to a micro have been greater than we had planned. There is a constant stream of questions to be answered and software to be installed, as users become more excited about the possibilities for data analysis. Managers have responded to the support by the Computer Center with their own support for our budget and staffing requests.

The project initially was aimed at providing quantitative tools to managers; this has been accomplished. The work of managers is not, however, limited to dealing with trend analysis, dealing with exceptional cases, and planning for the future; there is also a substantial component of mundane reporting and record keeping. By improving the managers' ability to deal efficiently with the mundane, more time has been made available to address planning issues.

Baldwin-Wallace is currently experiencing significant enrollment gains. Because this is expected to be a short-term situation, staff has not been added to respond. The productivity gains provided by microcomputers have allowed us to take full advantage of a short-term opportunity.

The most gratifying results have been a dramatic increase in both short range and long range planning, and the increased integration of planning among administrative units. Some specific results of this program:

LOTUS 1-2-3 was used to analyze results of changing the faculty workload, with emphasis on class size and cost to the institution.

Academic department requests for new faculty are now evaluated in terms of five year trends in class enrollment.

Upper level section planning now uses lower level enrollment analysis. Studies of the implications of requiring students to take more upper level classes are being conducted.

The cost of moving the college up in the AAUP salary rankings has been analyzed.

Audit schedules for all financial departments are now produced on microcomputers, reducing the time required for the annual audit.

We are currently involved in re-accreditation studies. Most reports and analysis for this study are being prepared on microcomputers.

Analysis of capitalization strategies for construction of a new Health and Recreation Center was performed.

The Development Office tracks the return rate of mailing pieces to determine the effectiveness of segmented mailings.

The Registrar is using ACT computerized data to study trends in the geographic distribution of applications, and to shift emphases in recruitment.

Conclusion

Utilizing microcomputers has improved the managerial productivity at Baldwin-Wallace College. Improvements have resulted from reducing the time spent on mundane activities and by providing new, quantitative tools for planning. Managers are eager to expand their skills but require training to take advantage of both technology and techniques. A variety of training methods have been used, the most successful for us being the seminar approach in which the manager-student applied microcomputing resources to a current problem.

The early successes of the project have included specific, cost cutting applications and increased interest in planning. Those who were trained first have been missionaries to their colleagues, expanding the range of planning activities. The managers' desire to grow has exceeded the human resources of Information and Computer Services but the problem is a welcome one.

HOW DO YOU SUPPORT A CAMPUS-WIDE OFFICE AUTOMATION SYSTEM AND END USER SERVICES?

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In recent years, two California State University campuses, Fresno and Hayward, have established "Information Centers" (IC) to support end-user computing, which includes campuswide office automation (O/A) projects. Over this time, the campuses have had to address such issues as: is the IC concept appropriate for end-user support, which services to provide, how to provide these services, whether to standardize, how to hire and keep good staff, and (of course) how to work with user steering committees. This paper discusses the experiences of these two campuses--what worked, what did not work, what we would do differently, and what we would do the same--in an attempt to enlighten the path for other campuses starting down the road to establishing end user support.

I. Descriptive Information

A. CSU, Hayward

The Hayward campus is an urban, commuter campus located in the San Francisco Bay area. The student population numbers approximately 9000 with 1200 faculty and staff. Office automation facilities include some 400 office workstations (IBM PC and AT&T 6300) linked via a fiber optic/twisted pair asynchronous network to a bank of nine AT&T 3B2/400 minicomputers which are in turn linked to the campus's administrative "mainframe", a CDC Cyber 830. Office automation is supported by an information center staffed by a manager (who also manages instructional computing support), a system administrator, two and one half consultants/trainers and four electronics technicians (who also maintain instructional equipment, other administrative equipment and the data networks on campus). The information center is a unit within Computing Services and works closely with other units in Computing Services to fulfill its mission.

B. CSU, Fresno

The Fresno campus is located in the middle of California's San Joacqin valley which is the major produce growing region in the state. The campus' student population is about 18,000 with about 800 faculty and an equal number of staff and administrators. The "office automation" solution for the administrative (including academic) offices are clustered microcomputers attached via a local area network. Specifically the microcomputers are manufactured by Convergent Technology, contain 80186 or 80286 cpus and are connected in clusters of six to twenty workstations that share software and hardware (hard disks, printers, and communication ports). Each cluster is in turn connected to the campus mainframe by emulating a 3270 bisynch cluster. The office automation and information center support is organizationally a part of the campus' computer center instructional area. The staff that specifically supports these functions consists of an assistant director of computing, a coordinator of office automation and training, several trainiers, two equipment repair technicians and half a dozen student assistants. The computer center operates three training/information center laboratories for the exclusive use of staff and faculty.

II. The Information Center

A. Concept

The goal of an information center is to promote and support end-user computing, thereby enhancing productivity and advancing overall computing efficiency at the university. An information center provides users with proper training, technical support, usable tools, data availability, and convenient access to systems, so that they may directly and rapidly satisfy a large portion of their information systems needs. Through training, user-friendly software, technical assistance, and consulting, an information center enables users to produce their own reports, efficiently communicate with other offices, access needed data, and develop applications specifications for use by Computing

Services analysts. As defined here, the university information center does not differ significantly from the corporate information center. However, there is one noteable difference. Where the corporate information center serves a more-or-less homogeneous population of administrators, engineers, or what have you, the university information center serves a truely dichotomous population of administrators and faculty. The unique goals, activities, work schedules, and expectations of the faculty create special challenges for the university information center.

B. Function

The primary function of the information center is to guide and support the integration of office computer systems (primarily microcomputer based systems) into the campus´s overall communications and information systems. As such, the information center is an agent of change, facilitating the evolution of the university´s information systems from yesterday´s centralized batch systems to today´s distributed online sytems.

III. Standards

A. The Case For Standards

It is difficult to imagine a successful information center without standards, that is, a list of products (hardware and software) for which the center offers support services. Among corporate information centers, the question of whether or not to have standards was settled in the affirmative years ago. Yet at many universities, the question persists. This is due mainly to the diversity of university faculty needs. Faculty´s primary professional goals deal with instruction and research, not office products. Office products are simply productivity tools to most faculty. It is important to differentiate the need for standards in office products and and the need for state-of-the-art tools for creative instruction and research. The key to understanding the need for office product standards, however, lies in understanding the relationship of standards to the support function. The quality of support offered by an information center is dependant upon three factors: the resources available for support (primarily staff); the number of products supported; and the depth of support offered (how detailed are the support services, from merely listing products approved for purchase to offering training, consulting, installation, maintenance, etc.). The three factors, which make up the support "triad", interact to determine the quality of support offered. A change in any one factor, without compensating changes in the other two, will effect the overall quaility of support. In other words, if an information center´s goal is to provide a resonable range of support services (i.e. a reasonable depth of support) on a large number of products, then the center would need a very large staff and budget. Most information centers have limited staff and budget, but still try to provide a broad range of support services. Hence the need for a limited number of supported products. The limited products that the information center supports are the "standards".

B. The Standards Manual
The standards manual can prove to be an essential part of maintaining standards while minimizing political fallout. The manual aides in communicating to the user community both the need for standards and the services offered in support of the standards, as well as the standards themselves. The manual begind with a section on the concept of the information center, its goals and function. The manual should explain why standards are necessary and how they are set. It should list all supported products and describe the services offered in support of each product listed. It also contains a section on how the user acquires a product, how support services are obtained and a contact list for help or services. Finally, the manual must be widely distributed on campus and heavily promoted.

C. The Upgrade Challenge
Once it is agreed that standards are necessary and those standards are set, the challenge is not over. Change is the nature of our business. New products come on the market daily and new needs develop almost as frequently. Whether or not to add a product and when to change or upgrade a product become ongoing questions. Given the support "triad" (the three factors which interact to determine the quality of an information center´s support), it is obvious that adding products to the support list without increasing staff or reducing services will degrade overall support. Hence, adding, changing, or even upgrading products must be seriously considered. (Note, for example, the upheavel being caused in some organizations by the appearence of IBM´s PS/2.) One effective way to upgrade is to subsidize the change, i/.e. buy the user the new product on the condition that the user stop using the old product. If funding is unavailable for this, the old product can be de-emphasized (e.g. reduce the number of training session, newsletter articles, etc.) in favor of the new product. The goal of either of these two methods is to replace products rather than to add products. In either case, salesmanship is essential.

IV. Support Services

A. Consulting
The most effective consulting approach, but, alas, the most resource intensive, is the cradle-to-grave approach. Here, users are guided from the initial stages of planning for office automation onward. Support includes helping users determine which office functions should be automated, determining system specifications, acquiring and installing systems, and helping users write their own applications. User written applications should be developed in a language/data manager that is supported by the center so that the end user can receive some level of support. The information center can, when an application is nearly university-wide, choose to write and support certain applications. The center also assists offices in analyzing their

hardware and software needs, understanding specifications, and selecting appropriate tools. Supported hardware is inspected on arrival, tested, delivered and installed in the user office. Consulting and training on the use of the hardware is also provided. Software is installed for the user by center staff. An extensive software training series is provided, as are a hot line, drop in question answering, in-office consulting, and extensive "hand-holding". It should be clear that such an approach is very user contact intensive. True, it takes considerable resources, requiring one consultant and one repair technician per every one hundred office workstations to work well, but the results are impressive. Users acquire new skills rapidly and many offices are able to develop automated systems simultaneously. Users also feel that the information center is providing a valuable service which, together with the high visibility of center staff, facilitates acquiring additional resources for the center. When the resources are unavailable to properly staff an information center, an alternative approach could be the use of a department or school "guru". While the guru approach has some success in the instructional areas, it is less likely to succeed in the office products area. The designated guru is more likely to want to offer services to fellow academicians than to staff or administrators, and usually has a heavy teaching and research load. Another problem is that some areas will not have anyone available to serve this function. However, this approach is still feasible with adequate committment and, of course, some release time.

B. Training.

Training may take several forms, including classroom training, one-on-one sesions, self-paced training (CBT, video courses, etc.), and hiring outside trainers. The best approach combines each of the above, but with an emphasis on classroom training. Classroom training makes use of the expertise which exists in the consulting staff of the information center. It is an efficient way of training a large number of users on a given task in a reasonable amount of time. Self-paced training has not been as eagerly accepted (as classroom training) by most administrative staff, particularly clerical staff. However, self-paced training has a place in providing a means for review and in handling special needs, where the time and effort required to develop a classroom course for a limited number of users is not justified. Training for users with special needs can also be accomplished by using one-on-one training sessions, articles in newsletters, user group meetings or by sending the user to an off campus agency for training. Hiring an outside trainer is usually too expensive for the campus, given that training is an ongoing task with new staff joining the university on a continual basis. However, in some cases, outside trainers are a good solution. One such case is the installation of a new system, such as electronic mail, requiring many users to be trained in a short period of time or on a one shot basis.

C. Equipment Maintenance

A hotly contested issue is whether to maintain equipment in-house or to contract for off campus service. If the campus already has an electronics shop which maintains other equipment, then it is usually more efficient and cost effective to expand this service to include office systems than it is to send repairs off campus. There are some exceptions, of course, most notable are hard disk repairs. However, even if repairs are done off campus, information center resources are needed to determine when repairs are needed, and to arrange and track repairs. In-house repairs allow service calls to be made in a timely fashion (often within an hour of the report) and when coupled with a "loaner" policy (where a failed device is replaced with a "loaner" should the failed device need to be removed from the office), promotes minimal down time and a very happy user community. The important issues that need to be faced when evaluating in-house or out-of-house repair are the true costs of both options. These costs include spares and parts, diagnostic equipment, office space and personnel costs, and (often overlooked) the cost of lost productivity when the office workstation goes down.

D. Centralized Data Bases

At the heart of administrative computing (with which office systems often interact) are the university´s centralized data bases, such as student records and financial records. To be effective, office systems must be able to extract data from these data bases. Campus-wide standards, strickly adhered to, promote ease of interfacing office systems and central systems. Difficulties with communications connections and protocols are minimized and systems development and training are facilitated. With access to sensitive data, come issues of data security. Establishing clear procedures for gaining approval to access such data helps maintain the integrity of the data. However, once the data is downloaded to an office machine, only the office user can insure its security. Discussion topics at user group meetings and articles in newsletters help educate office users to the issues and problems involved.

E. Centralized Administrative Systems

The information center´s function is to support end user computing. However, end user systems often interact with or otherwise depend on centralized administrative systems. Therefore, information center consultants need to be cognizant of administrative systems. They need to be able to advise users of optimal solutionsregardless of whether these solutions involve microcomputers or mainframes. They need to know how various products and existing resources can best be utilized and how new applications will effect old applications. They also need to know when to call in a systems analyst to make such determinations. Consequently, it helps to have both the information center and administrative systems in the same reporting line. Regular meetings between the two groups to discuss developments are essential, as are good person-to-person relationships between the groups. Rivalries must not be allowed to develop. It is important to promote the idea that the functions of the information center involve the efforts of both groups.

F. Information Services

A large part of the information center's job is to distribute information to users. Training sessions, of course, are one means of distributing information. There is also a need to distribute answers to common questions, helpful hints, product descriptions and the like. User group meetings are an excellent method for "getting the word out". Such groups should have regularly scheduled meeting, and be an informal affair perhaps with refreshments. The information center manager should encourage other unit managers to allow their employees to attend. Information center staff should serve as resource people to the user group, but the group should be under the control of the users themselves. Newsletters devoted to univeristy computing should contain regular sections dealing with office systems. It also helps to be creative in determining what these sections should contain. For example, instead of a dry, easily overlooked question and answer column, a "dear Abby" type column might be tried, where the questions are rephrased as amusing quandaries with equally amusing solutions. Or, establish a contest for the best user submitted tip of the month, or a crossword puzzle containing computer terms (an excellent way to promote computer literacy). Diversity and entertainment help relieve the feeling of being bombarded by overly technical material. Where long winded technical material (such as user guides) are necessary, they should be kept out of the newsletter. Instead, a series of technical bulletins should be established. If your office systems are interconnected, you can promote the use of the system by establishing a BBS (an electronic bulletin board) on your network. The BBS could contain such non-job related features as a jokes board or a recipe board. Although this may appear to "waste" resources, it is actually an effective way of getting office personnel to use the system and learn to feel comfortable and at home with the new technology.

V. Staffing

A. Obaining Adequate Numbers

Adequate staffing is critical to the support approach described above. The one hundred-to-one ratio was mentioned above. The ratio provides one consultant and one technician per one hundred office workstations. Such staffing represents a serious investment on the part of the university and the information center manager should continually lobby for adequate staffing. Promoting the center (see section VI) is an ongoing and important task which can yeild benefits when arguing for additional staff. A development plan for the center should be designed which includes a section on staffing. The plan must be realistic and well justified (particularly when calling for increased staffing) and have the full support of senior administrators. It helps to pass along to those administrators articles from the trade press which lend support to your plans. Keeping records of user contacts, training session attendees, project progress etc., and circulating reports based on such data also helps keep administrators informed of the center's needs.

B. Retaining Competent Staff
With many institutions establishing and expanding information centers, the opportunities for center personnel are currently quite good. Retaining good consultants and technicians is a problem which the information center manager must address (particularly at universities where salaries often lag behind industry averages). Listening to the concerns of your staff and acting accordingly is an effective strategy. Keeping the amount of time consultants and technicians spend on clerical tasks to a minimum is also a good recommendation (assign such tasks to clerical staff). Consultants are very "people oriented" and don´t like to confront users with limiting policies and bureaucratic red tape. Consultants should be encouraged to refer all such questions to the information center manager. Another useful technique is to allow time in staff schedules for study, reading and attendance at seminars which allow staff to stay current or improve their skills. The opportunity to increase one´s knowledge by attending off campus training sessions is often a strong point in retaining staff. In order to complete these objectives it is important to establish an annual budget for specialized training for information center staff. While it is often tempting to take on tasks without the necessary resources, this is generally a poor idea for an overworked consultant is ripe for moving on. It helps to remember that consultants and technicians are the heart and soul of an information center.

C. Optimizing Staff Resources
Augmenting the professional staff with student assistants can help stretch staff resources. It should be remembered, however, that student assistants are not (yet) professionals. They are perhaps best used in situations requiring minimal training and minimal knowledge of administrative policies and practices. For example, students can be effectively used to staff an evaluation center (where faculty and staff come to try out products) and as assistants in training classes. Students can also be used to do clerically intensive tasks (e.g., graphing data on user contacts), thus offering relief for the consultants. With careful screening, it is possible to use students in more demanding situations, such as sceening hot line inquiries. Another technique for stretching resources is the use of staff interns. In this approach, personnel from other departments serve as interns in the information center. The interns work a few hours a month or semester (what ever their home department can live with) in the information center where they may teach classes or answer hot line inquiries involving products they have used and know well. They may even be used to visit departments facing problems or issues which the intern has already solved in the home department. The home department (in return for giving up a few hours of the staff member´s time) gains a staff member with increased knowledge of a product (the kind of knowledge acquired through teaching a workshop). The interns get a break from their usual routines, a chance to improve their skills, and experience which may, on occasion, lead to a career change. Among the more "traditional" ways to stretch staff resources, Computer Assisted

Instruction holds much promise for reducing the traing load. However, it has yet to fulfill that promise at most institutions.

VI. Staying Alive

A. Marketing the Information Center

The information center is a new concept for many and seldom appears on a university´s organization chart. It is often not clear to administrators what the center does, why it is needed and (most importantly) why it is so staff resource intensive. There is often a feeling that once the equipment for office automation has been bought, the problem has been solved. To combat such mis-impressions, the information center needs to be "marketed". The university community needs to be informed of the center´s mission; its function, goals and operation. Newsletter articles on the center itself are useful. The information center manager can also use various committee meetings to promote the center. It is also possible to impose on those administrators who are aware of the center´s benefits to speak with those administrators who are not yet aware of the center´s value. An excellent technique is to select a department which has not benefited from the center´s services for some special attention. A consultant can visit the department and, working with the department head, can often quickly find areas where the departments operation can be improved or facilitated by taking advantage of the information center.

B. User Steering Committees

User steering committees are often thought of as a nuisance. However, if properly constituted and managed, they can provide much useful information on user needs and opinions. They can also help promote the benefits of the information center. If possible, the information center manager should sit on the committee and help determine its members. Steering committees can become counter productive if an antagonistic relationship between the information center and the committee is allowed to develop. This can be avoided by selecting members who are knowledgable concerning the center and who represent a broad range of positions within the university. Keeping the committee focused on user related issues, rather than the day-to-day operation of the center, is also helpful.

C. Evaluation

In-house, self evaluation is useful in preventing the information center from stagnating and keeping plans in touch with changing user needs. The information center development plan and usage data should be reviewed periodically by the center´s manager with the help of the consultants and head technician. When the review is done on a regular periodic basis, change in the center becomes a smooth, evolutionary process, rather than a stressful, chaotic one. This is good for both users and center staff.

D. Charge Back

Running the information center as a cost center is an attractive idea. User are easily made aware of the value of the center´s services. However, in a university settings, charging for information center services is probably not a good idea. The center exists to facilitate end user computing. Putting a charge on services places a barrier between the center and those it is trying to help. Also, charge back encourages users to seek alternative solutions and make decisions based on cost alone, often without knowledge of the very interrelated nature of office systems. Given the function of the center in guiding the intergration of office systems into campus-wide communication and information systems, and the importance of maintaining standards, such maverick solutions, while costing less in the short run, could cost dearly when everything must work together. At the very least, charging for services should not be undertaken lightly and each service offered should be evaluated separately.

VII. Recommendations

This paper summarizes the experience of two campuses of the California State University system in providing for end-user support, concentrating on what has worked well on these two campuses. Through the experience we learned a few lessons regarding the initial establishment of an end-user support system for campus-wide office automation. First, a thorough needs assessment regarding campus office automation requirements must be accurately and throughly developed at an early stage in the planning for office automation. Second, the actual users of the system, secretaries, clerks, etc., as well as managers and administrators should be part of the team which develops the system´s specifications. Third, when a campus-wide network is being considered, a good deal of attention must be focused on the many details involved in connecting the various workstations and systems which will become part of the network. The state of network technology does not permit these details to be overlooked, for it is only after properly considering all the details that an accurate assessment can be made of the resources required and a plan developed. Fourth, the support problem is greatly eased by a fully integrated system, one in which all software and hardware is designed to work together as a unit. Finally, and most importantly, the university´s senior administration must be made fully aware of the scope of the challenge from the very earliest planning stages. It is particularly crucial that the administration understand the need for adequate support resources, primarily staff resources, and that it commit to providing those resources. The view that the process is primarily a hardware issue must be altered. By its nature, the support of end user computing is staff intensive. This is the point which must be clearly understood.

CONTINGENCY PLANNING: A CALL TO ACTION

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ABSTRACT

Computing centers are becoming such critical resources to the daily operations of most institutions that many could not survive long without them. A little foresight can significantly reduce the vulnerability of computing facilities, while improving the ability of the institution to continue operations in the event of an interruption in computing services, and to reducing the duration of such outages and associated costs of recovery.

Contingency planning should address a broad range of issues including assessing risk exposure, identification of vital and critical needs, and alternatives available to support those vital and critical operations, alternative information processing facilities in the event of an outage, and recovery and restoration of local computing facilities.

Contingency planning must be incorporated into the systems development life cycle and the daily operations of both operational departments and computing centers. Contingency planning must be viewed as an institutional obligation - not as a computing center plea.

CONTINGENCY PLANNING: A CALL TO ACTION

Introduction

Most computing professionals understand that the operation of their data center is a critical resource of their organizations. They also realize that this concentration of resource is sensitive and vulnerable to a range of natural disasters, man-made disasters, and even to malicious attack. Still, evidence suggests that nationally fewer than one data center in four has a current, tested contingency plan. For these centers, their strategy for dealing with an interruption of services is total risk acceptance. This attitude stems in part from the perception that little else can be done, in part from the search for and absence of global, easy, or miraculous solutions, in part from a reluctance to involve senior managers and end users, and in part from a lack of understanding of how to arrive at an effective plan.

Generally, most of us think of disasters in terms of events characterized by low rates of occurrence, high levels of uncertainty, and devastating consequences. Most managers will not see a disaster of this magnitude in their careers. For example, since the birth of the data processing industry, catastrophes can probably be numbered in the low hundreds. When these are compared to the hundreds of thousands of "installation years", it becomes obvious that a given installation can expect to see a catastrophe or major disaster something less than once every one thousand years. Most businesses that have encountered such events have recovered; few have had more than a rudimentary plan.

On the other hand, data center operations are becoming so integral to the operation of colleges and universities that many could not continue normal operations long without it. A little foresight can significantly reduce the susceptibility of computing facilities to damage, improve the ability of the institution to survive outages, and reduce the duration of the outage and associated costs of recovery. It follows, then, that we as prudent managers should invest the necessary foresight and consider the broad range of issues associated with contingency planning efforts.

Planning Scope

It is important to note the term "contingency planning" rather than disaster recovery planning. Recovery planning is certainly an important component of the overall efforts, but is not inclusive of the range of activities embraced under the broader concept of contingency planning. Contingency planning recognizes that data center services can be negatively impacted by a myriad of occurrences up to and including disasters of monumental consequence; and that these impacts can vary in duration as well as impact levels. Contingency planning begins with an assessment of risk exposure and addresses alternatives to reduce the vulnerability of the data center. Next, the planning process should address the impact of the absence of data center services on the ability of the institution to conduct its affairs and provide expected services. The next step should consider the business and service needs of the end users of data center services and how those necessary and essential operations can be accomplished in the event of a sudden loss of computing support. And finally, the planning process should address those emergency strategies essential to enable the data center to contain the damage resulting from a disaster, to provide backup (albeit limited) computing services, and to initiate a recovery sequence which ultimately results in full and permanent restoration of services and facilities.

Plan Objectives

The objectives of a contingency plan are to make sufficient agreed-upon preparations, and to design and have ready to implement an agreed-upon set of tested procedures for responding to an interruption of services in the data processing/information services area of responsibility. The purpose of these procedures is to minimize the effect of an interruption upon the missions and operations of the various units of the university. The emphasis should be on safeguarding the vital assets of the organization and ensuring the continued availability of those institutional services and functions that are determined to be critical and vital to the organization.

A contingency plan should cover all aspects of the total or partial cessation of operations in each computing facility. This type of planning includes procedures as well as equipment and personnel for both automated and manual recovery procedures, both at the end user offices and in the data center. It also includes migration to, and operation of back-up sites, should that prove necessary. The personnel responsibilities associated with the plan must be specified and well understood. Complete or partial "disaster drills" and other more controlled methods of testing must be a regular part of the process.

Reducing the likelihood of a disaster and minimizing the extent of destruction through security and detection measures such as fire alarm systems, water detectors, sign-on passwords, specially locked doors, and the like, can be employed to minimize the accidental or intentional disclosure, modification, or destruction of data, or the loss of the means of processing data. However, security measures can fail with damaging results to the data processing facilities and thus to the institution. Contingency plans should be designed to reduce both the likelihood of an interruption or loss of computing services as well as to minimize the consequences of the loss of any computing resources or capabilities. Contingency plans do not merely mean planned responses to major catastrophes, but are also intended to reduce the detrimental consequences of unexpected and undesirable events of almost any magnitude.

As a practical matter, the greatest probability is that damaging occurrences will be less than catastrophic, and they will be confined to a small area of a total facility. However, the size and scope of a disaster and its effect on the computing operations are often not directly related. For example, a relatively small fire in the computer communications area could be widely disruptive to a facility's operations, while the loss of a few terminals in a completely destroyed building could be recovered rapidly. Computing operations are so interconnected that contingency plans must address the entire range of activities and services in each facility.

Given the growing institutional dependence upon computing services to support a broad range of instructional, research, and administrative needs, an institutional commitment to address contingency and recovery planning is essential. Recovery planning in support of computing resources must be an organizational commitment and not merely a computing center obligation. Both the academic and the business impact of the immediate absence of partial or total computing support must be recognized and understood in order to proceed with developing a plan for recovery of essential functions and services.

The Need

Every organization must look at the consequences of loss of their computing resources and consider their risk exposure. It is simply good business practice for an institution to examine the possibilities for disaster and to estimate its exposure in each area. Translated into a college or university environment, those essential and vital activities of the institution which must be restored to an acceptable level of service within prescribed time frames must be defined. The definition process must involve the end users of computing service who, in concert with representatives from the appropriate computing facilities, can specify those activities which are essential and vital. In general, for an activity to be essential and vital, its unavailability should result in:

1. The creation of a life-threatening situation; or
2. A significant loss of assets (Physical Plant) or financial resources (dollars) to the university; or
3. An inability to meet critical and essential commitments to students, faculty, staff, or state or federal agencies; or
4. The inability to meet contractual (legal) and/or service obligations.

Some examples of the potential impact of the loss of computing services at a college or university include:

1. Inability to meet internal and external reporting requirements.
2. Inability to provide research and instructional computing support.
3. Diminished ability to maintain personnel and associated payroll records.
4. Inability to provide academic and instructional support services in such diverse areas as admissions, student records, financial aid, and human resources.
5. Reduced ability to register students and collect fees.
6. Inability to support instructional efforts requiring computing facilities.
7. Inability to support alumni constituency activities as well as institutional development and fund raising activities.

8. Diminish the quality of patient or client care at affiliated hospitals and/or clinics.

9. Inability to process patient/client bills and statements, resulting in reduced cash flow in hospitals, clinics, or service clearing operations.

Commitment to Action

Contingency plans must address both the "day-to-day" hassles as well as the "once in a thousand year catastrophe", and should be firmly implanted into the standards and operating procedures of the data center. The plan should be firmly grounded in the operational procedures of the users of the center and reflect their involvement and commitment. Through the explicit support of our end users comes the essential expression of institutional commitment which is vital in ensuring a contingency plan remains viable and functional. Recovery of essential computing services must be an institutional concern, in addition to a computing center concern. Those organization and institutions that have grasped this essential concept have viable contingency plans; alternatively, those institutions which continue to view recovery planning as merely a technical exercise, seldom have current and usable recovery plans. For recovery planning to succeed it must have institutional commitment in the form of recognized (public) acceptance of the need for a plan as well as access to necessary corporate and institutional resources in the form of dollars and personnel.

Alternatively, a recovery plan which lacks the imperative of institutional commitment will typically be little more than a technical blueprint to re-establish some pre-determined hardware capability at an alternative location. At best, this approach offers the computing center director a false sense of security which will last until the first execution (because of either a routine test or an actual disaster) of the plan. This approach often results from either an institutional mandate (auditors, statewide directives, etc.) or from the "something-is-better-than-nothing" syndrome on the part of the computing center director. In either case, the lack of broad-based user involvement and commitment in the recovery planning effort ensures that the institution will remain vulnerable.

While most computing professionals recognize both the need for recovery plans and their responsibility to ensure such plans are developed, they often are unable to marshal the necessary institutional commitments. Frequently, the discussion of recovery plans is framed around technical issues such as size, capacity, telecommunications, etc. In this context the costs (new) for a recovery plan must compete with other computing costs (new and recurring) for operating hardware and software. The decision reverts back to the computing professional from senior management, with the admonition to "work it out" within the context of other computing priorities. The burden shifts to the computing manager to justify the recovery plan from a computing perspective, instead of to the users of computing services to justify from an institutional and operational perspective.

The rationale and justification for recovery plans must be premised upon the business case of the sudden interruption of computing and communications services and the resultant impact upon institutional activities. Both institutional management and computing/data processing managers should recognize that establishing and maintaining a dynamic and functional recovery plan is a necessary, ancillary cost of doing business; and that these costs are outside of and in addition to the current operating expenses associated with computing services.

Development of the Plan

As noted earlier, recovery planning must address a continuum of eventualities. The plan, of necessity, should be subdivided into logical and related actions to recover operational activities. While cognizant of the potential impacts of major catastrophes, the plan must also address more limited aberrations in the availability of computing services.

Planning for recovery activities should be embedded into the routine operational standards and procedures both in the computing center and in user offices. Both computing staff and user personnel should consider recovery objectives during routine design reviews and throughout the systems development life cycle. Recovery objectives should be integrated with and consistent with operational objectives. The ability to conduct at least at a rudimentary level, essential business functions in a manual or semi-automated fashion should be continually reinforced to both users and technical staff. Consider for a moment the consequences of developing a highly automated, technically sophisticated computing service or application for an end user, which in the absence of computing services would render that office or user group incapable of conducting even basic business operations. In the event of a loss of computing services, the likely ensuing scenario results: "The computing center talked us into this application, never told us that their equipment might fail, and never told us how to get the information for us to get our job done if the system wasn't available...". Recovery and restoration of business activities must be embedded into the fabric of the systems development life cycle.

Strategies and Procedures

Recovery planning usually begins at very basic levels with routine procedures, facilities, and policies. Effective strategies for recovery are premised upon establishing standard procedures for early detection of problems, analysis of their nature, and containment of their potential impact. To minimize potentially catastrophic events, electro-mechanical mechanisms such as smoke detectors, motion detectors, and heat sensors should be in place, as appropriate. Evacuation plans, notification sequence of civil and campus authorities, and emergency shutdown procedures must be established and broadly understood. Problem identification and tracking procedures are important. Regardless of the magnitude of the potential problem, end users and computing staff must share responsibility for problem identification and analysis. In this context, reliable and accurate communications among computing staff and end users is critical. Communications must be clear, responsibilities unambigious, and action consistent to ensure the nature and scope of problems are accurately diagnosed, analyzed, and disseminated.

Immediately following upon problem identification and analysis is containment. Containment should not be confused with resolution. Containing, or isolating a problem involves separating cause and effect, and differentiating the root problems from symptoms. Containment also involves interrupting and diverting a sequence, that left unchecked, may escalate to more disastrous levels. Containing and isolating problem situations is the necessary precursor to problem resolution.

Determination of responsibilities and establishment of an appropriate action plan are also necessary to accomplish problem resolution. As the sequence of problem identification, analysis, containment, and communication unfolds, critical decision points emerge. Clearly understood decision-making responsibilities must be established consistent with organizational structures and priorities. Critical time should not be lost because of uncertainty over who has what authority for what action in a given situation.

Actual problem resolution is the sum of the preceding activities: identification and analysis, containment and isolation, decision points and decision responsibilities. Problem resolution is a combined activity representing the coalescence of technical support and user expertise and judgment. The actual resolution sequence and the particular actions and staff required will reflect the nature of the problem. The problem resolution process in a recovery plan should be situational and temporal, determined by the nature of the problem, rather than by a narrow, rigidly proscribed decision/responsibility matrix.

Implementing the Plan

If the processes leading to problem resolution are embedded in the systems development life cycle methodology of the organization, then the formal declaration and adoption of a disaster recovery plan is relatively straightforward. And perhaps more importantly, the plan can remain dynamic and vital as evolutionary changes occur to either the hardware or software environments. When effectively implemented, a formal disaster recovery plan is an extension and formalization of various existing operational procedures into a coherent problem resolution and service restoration process. Specific operational details, such as backup facilities (hotsites, shell sites, etc.) are merely technical issues driven by operational needs. Staged recovery options which consider for example the first 24-72 hours after a disaster, the next 48 hours, and beyond, can be evaluated in the context of the service and business obligations of the institution. In sum, the actual recovery plan is a compilation of existing procedures developed in recognition of the business needs of the organization, accompanied by a technical support strategy which stages recovery options consistent with service obligations. Most importantly, the plan becomes a corporate statement of commitment, rather than a computing center's plea for relief. The scope of a recovery plan, adoption of a recovery strategy, and associated cost is focused at the institutional level, rather than at the departmental level.

When approached in this fashion, recovery planning can be both manageable and achievable. The various alternatives, responsibilities, and actions necessary to deal with the range of potential interruptions to computing services can be clarified and understood by both user and technical management. The essential nature of recovery planning is expanded beyond recovering the computing center to focus on recovering vital operational and business functions and minimizing the impact of the absence of computing services. While problems and disruptions of service should scarcely be called routine, the presence of a contingency planning and recovery methodology as outlined above can ensure that an appropriate response to contingencies of various extremes is part of the standard routine of the institution.

SOFTWARE UPGRADES: CHALLENGES AND SOLUTIONS

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ABSTRACT

This paper will present a step-by-step methodology for introducing software upgrades within organizations. It will examine ways of including users in the decision-making process to help gain their support. It will also give approaches to evaluating software based on the needs of the organization. In addition, hidden problems and costs that result from software upgrades will be identified.

Introduction

In today's market, software versions seem to change as often as car models. At a seminar given in Washington D.C. last year, a representative from a major software company said that when their developers finish a new version, they go on vacation for a couple of weeks and then return to begin work on the next version. The constant introduction of new products into the marketplace forces managers to decide whether the latest product is worth the cost and disruption that usually accompanies change. This paper will present a process to determine whether or not to upgrade. It will also provide methods to implement an upgrade. While the information presented focuses on organizations with centralized management of office automation, individual users faced with the upgrade challenge may also find it helpful.

Software companies offer upgrades in a number of different ways. If the upgrade is taking place because the original version had bugs in it, the replacement version generally costs the customer nothing. What companies often do, however, is correct the bugs and add new features. When the company publicizes the new product, they advertise the new features rather than the corrected bugs. In this case, the customer can expect to pay for the new product. Often, a special trade-up price is offered to users who own one of the previous versions.

Identifying Hidden Costs

The Requirements of Software Companies

The software companies have various administrative procedures that they require when upgrading. As these procedures affect the amount of staff time needed to upgrade and the number of upgrades purchased, they are important factors to consider. Companies may require that customers:

1. Register their current version before upgrading.

2. Return all or part of the entire package before upgrading.

3. Return the old package after receiving the upgrade.

4. Purchase by a certain date to obtain a special upgrade price.

5. Pay the full cost of a new package if they miss a final deadline.

It becomes fairly obvious that research of the upgrade requirements must take place soon after the upgrade is released. This way, a quick decision concerning upgrades can be made and unnecessary expense is avoided.

Current Hardware Configurations

There are other factors to consider which can affect the cost of an upgrade. Current hardware configurations must support the software upgrade. For example, if the new software requires more memory or graphics support to run and the configuration does not currently provide this, memory upgrades and graphics cards should be in the cost estimate. Do not overlook printers when evaluating the new software. Make sure that the software will support current applications with all printers. In addition, make sure the printers will support all new features included with the software.

The Discontinuing of Older Versions

Also take into account that software manufacturers typically discontinue distributing older software versions shortly after new versions are introduced. This practice presents consumers with the following choices:

1. Upgrade all current versions to the new version.
2. Upgrade packages only for users who require the new features.
3. Shuffle the packages throughout the organization to make sure each office is not using more than one version of the software for compatibility reasons (license agreements permitting of course).
4. Select another software package that will better meet the needs of organization and adopt it in addition to the current software.
5. Replace all the current software with another software package that will better meet the needs of the organization.

Each one of the options above involves cost factors that should be included in the upgrade plan.

Discounts for Volume Purchases

Software companies frequently offer discounts depending on the quantity of upgrades purchased. These prices, along with special trade-up prices, usually have a time limit, after which they are increased or discontinued. If the organization does not have an office that centrally manages the purchase and distribution of software, the purchasing office may agree to combine all requests for a particular software upgrade on the same purchase order to take advantage of the discount.

Support Agreements

Generally, the more convenient and flexible a support agreement, the more it will cost an organization. Because of the enormous number of telephone calls they are receiving from users, some software companies have decided to charge for technical support they previously offered free to registered users. Some of them have both corporate and individual support agreements available for purchase. Following, are some of the features that may appear in the various agreements:

1. A limited number of telephone calls (not necessarily solutions) to a technical support department on a central telephone number where the customers are helped on a first-come, first-serve basis. The number called is not necessarily toll free and customers may have to wait several minutes before they are helped.
2. A special corporate line allowing quick access to an individual or group of individuals assigned to the customer's account. Customers may have either unlimited or limited telephone calls over a specified period of time.
3. On-line help where a technician will physically tie into the customer's computer via a modem and call up the customer's session on his/her computer to analyze the problem and provide a solution.

License Agreements

The number of software upgrades purchased based on the organization's needs and the license agreement restrictions will affect total cost. Some software companies have license agreements allowing the use of a software package on more than one personal computer as long as it is not used on more than one concurrently. This practice means that if there is not heavy usage of a particular software package, two or more users could legally share one package and and use it on personal computers at their individual locations. Other software companies, on the other hand, have license agreements requiring that a specific software package be used only on the personal computer to which it is registered.

Staff Time

Do not overlook staff time as a cost factor. The upgrade process can take a great deal of time depending on the number and sophistication of the users affected.

Consider that staff may become involved in the following ways:

1. Evaluating and testing software.
2. Attending meetings to update the advisory committee.
3. Surveying and interviewing users.
4. Collecting necessary information and/or materials to take advantage of volume purchases.

5. Documenting the new features and how to use them.
6. Distributing software and testing it on users' configurations.
7. Providing follow-up support after distributing the upgrades.
8. Providing training to users on both an individual and group basis.

Based on the responsibilities given above, it should not come as a surprise to learn that staff could assume both temporary and ongoing time commitments with the upgrade program.

Deciding Whether to Upgrade

A Case Study

In 1985, a new version of a standard word processing package used by George Mason University (located in Fairfax, Virginia) was introduced by the software manufacturer. George Mason University has an Information Center (IC) which is responsible for the centralized distribution of new software and software upgrades to administrative offices. The IC staff began to seriously consider this new version because it would immediately solve three problems that users were experiencing. First, the older version was slightly incompatible with a new IBM clone (costing considerably less than the IBM PC) that had been adopted as a standard. Second, the new version allowed users to share printers via a local area network (saving the cost of purchasing additional letter quality printers) while the old version caused problems. Third, the new version allowed users to select one letter out of a series of letters created with mail merge (merging a list of variables with a primary document) and print it separately. The old version, on the other hand, required that the entire batch of letters be printed out each time a correction was made--a very time-consuming process. The major thrust to automate the University's offices with personal computers began in 1984. Formal training classes for administrative staff on existing software and hardware standards were started in June of that year and continue through the present. By the end of 1985 all the administrative offices had at least one personal computer and were using word processing (approximately 200 packages in total). A major investment was made in both the training of staff and the purchase of software packages. For this reason, in 1985, when the new software version was released, the University was not yet ready to consider changing to another word processing package.

Shortly after the IC staff decided to investigate the new version further, the software manufacturer released a second upgrade. For purposes of comparison, the older upgrade will be called upgrade A and the newer upgrade, upgrade B. The IC staff evaluated both software packages and tested them on the University's standard configurations. They discovered that upgrade B would require upgrading memory on all the standard computers on campus which at that time numbered over 400. However, despite this cost, they felt the users might find the new features helpful. Taking into account the lack of user sophistication and knowledge of features, the staff believed it was important to administer a survey which would gather information and expand the users' knowledge base. The survey briefly described the new features of both versions with examples of how they could apply them and the users were asked to rate how helpful each feature would be in their work. The survey was one page long and it was printed on an unusual color paper so that it would not get lost on users' desks. The instructions for its completion were simple and direct. The survey was sent to every administrative office on campus (approximately 130) and generated a response rate of over 70%. When the responses were compiled, it was discovered that users indicated a need for the features in upgrade A over a need for those in the upgrade B. The survey results and the results from the evaluation and testing of the software versions conducted by the IC staff were submitted to a group called the Standards Review Committee. This committee evaluates and recommends standards for the University's administrative staff. It is made up of faculty members, administrative staff, and technical support staff. Faculty members are included because the department secretaries support them using standard hardware and software. After a careful analysis of the information provided, the Committee recommended that all word processing packages be upgraded to upgrade A. The funds allocation to purchase the upgrades was then approved by the Vice President for Computer and Information Systems.

Testing

One area that needs further elaboration than is provided in the preceding case study is testing. Testing deserves a great deal of attention prior to distributing upgrades to avoid problems later. Testing is important for individual users considering upgrades as well as entire departments or organizations. Customers have more leverage with the software companies if they are negotiating for a large number of software packages. Frequently, the software companies are willing to send evaluation packages to companies considering the purchase of software upgrades. Sometimes they are even willing to send a representative from the company to demonstrate the new features or to answer questions concerning the new software. The latter often depends on the size of the company and the priorities they have in terms of the groups to which they market. Universities are not necessarily a top priority with all software and hardware companies.

When software companies develop new software they do not always design it to work easily with previous versions. A file created in one version will not necessarily work with another version. Sometimes the compatibility problem is so great that it is impossible to view a file created with another version. Other times only certain features will not work correctly. Deciding to upgrade software is not the same as deciding to buy new software. Testing of both the old version and new version is required. Look for performance problems in both the old and new features. The new features may cause the old ones to behave differently. The differences can be slight and still take hours of staff time to correct after distributing the upgrades to users.

Memory requirements are another factor that can cause surprises. Sometimes, the memory requirements given by the software company will not allow use of the new features to their fullest capacity. Examine the documentation for installing the software carefully to determine whether there is more than one approach with varying memory requirements. Unfortunately, even after someone with a great deal of technical ability has tested a software program, there is still a chance of overlooking something. Identifying test sites within the organization can prevent the distribution of software before the discovery of needed modification or major problems. It is probably best to select those offices with users who are already very enthusiastic about using the features available in the upgrade. Otherwise, they may resist making a change before other users in the organization.

Working with an Advisory Committee

If an organization has a centralized office handling office automation, and it does not already have an advisory committee representative of the target population, it may want to form a group for the purpose of recommending software upgrades. In this case study, the evaluation and testing was done by the IC staff. However, in other instances at this university where a choice was made between upgrading or adding additional software standards, a special task force reporting to the Standards Review Committee was recruited to do the evaluating. Having an advisory committee accomplishes the following:

1. It recognizes users who have become competent in the area of office automation.
2. It allows users to become involved in the evaluation and selection of their own tools.
3. It gives a group of users a vested interest in the success of an upgrade program and can help lessen resistance to change by the community.
4. It provides assistance to the central office for office automation that may be overextending its resources with the continual addition of new technology.

Administering the Upgrade Program

Maintaining Software Distribution Records

The first step in implementing the upgrade program is to locate the software packages needing upgrades. Hopefully, distribution records are already available. If not, this is a good time to start collecting this information. Use a database management software program to develop an application to track the upgrades as they are completed and to add to the permanent distribution records. The following information is a basis for this application:

- office name
- contact person's name
- serial number
- version number
- peripherals (e.g., printers, plotters, modems, etc.)
- enhancements (e.g., graphics cards, memory upgrades, etc.)
- date upgraded
- name of staff person upgrading
- problems encountered and solutions

In the "problems encountered and solutions" field, reference a text file stored in another location if more space is needed.

If the software registrations are not currently maintained, start doing so with the software upgrades. Software companies may require copies when purchasing a corporate support agreement, replacing damaged software, or upgrading again in the future. Keeping them on file can save time later.

When the staff distributes the upgrades, it is a good practice to ask the person accepting the upgrade to sign a form which includes an inventory of the package and says that the person signing verifies that all items were received. In addition, attach a copy of the license agreement and include a statement on the form indicating that the person signing it has read and understood the terms and conditions of the agreement. Maintaining these forms can prevent misunderstandings at a later date.

Installing the Software Upgrades

To reduce the amount of follow-up support needed after distributing the upgrades, it is best to install the software prior to distribution. Determine the best installation procedures with the various configurations in the organization and document them. Ask all the staff members working on installations to follow the same procedures. In some instances, the installation may have to be done in a user's office because of software or hardware restrictions.

Providing Training on the Upgrade

If the organization has a training program, adding instruction on the new software version is advisable. Options include incorporating the changes into currently existing classes or offering separate classes focusing only on the changes. How and when this is implemented depends on a number of factors. They include: staff and facility resources, the number of users receiving upgrades, the cost of training, and the degree of difference between the older and newer version.

Preparing Upgrade Information Packet

Distributing an information packet with the upgrade will help ease the transition. Begin with a letter from the central office's staff congratulating the users on the acquisition of the new software and briefly describing the new features. It is important that a telephone number that the user can call for follow-up support is included also. If appropriate, attach a sheet explaining any new error messages the users may encounter and what they mean. Document any substantial feature changes, providing step-by-step instructions for how to work with the new features if the software company's documentation is inadequate.

Distributing the Upgrades

Resistance to change is more likely to occur in this step of the upgrade process. It is not enough to deliver a software upgrade to an office if a smooth transition is desired. Remember, removing a tool the user is familiar and comfortable with and replacing it with the unknown creates stress. The following steps should ease the anxiety created by this exchange and help avoid pitfalls:

1. Schedule a visit during a slow work period in the user's office.

2. Ask the user to set aside some time to allow the review of new features and test the software with him/her.

3. Review the organization and content of the software company's documentation with the user. Also review the information packet with the user pointing out the follow-up support telephone number.

4. Test the user's configuration with the software to make sure that the software will run. Include the printing of a file in the test. The testing verifies that the installation procedures selected for this particular configuration was correct.

5. Correct any installation problems discovered before making the exchange. If the correction is minor, it can be made in the user's office. Otherwise, reschedule the meeting and make the corrections in the central office. It is important that this

process does not inconvenience the user in any way. This will help avoid creating negative feelings towards the change.

6. Allow time to discuss any concerns the user may have regarding the upgrade.
7. If there are any new features that a user will encounter immediately during the course of his or her work with which he or she is unfamiliar, show the user how to operate them.

Obtaining User Support

Two ways to obtain user support were discussed earlier: 1) involve users in the decision of whether or not to upgrade; and 2) distribute the software upgrades in a way that gives users a chance to learn about the new features and ask questions without disrupting their work. Another possibility is the inclusion of an article in an organization-wide newsletter recognizing the contribution that advisory committee members and survey respondents made to the upgrade program. In addition, offering a seminar demonstrating the new features and providing examples of how users can apply them is beneficial. George Mason University offers lunchtime seminars that normally draw a group from 20 to 40 users. The IC staff attempts to create an atmosphere that is relaxed and informal. Users are encouraged to ask questions throughout the demonstration and voice any problems or needs they might have.

Conclusion

Purchasing upgrades should be the result of careful planning using cost-benefit analysis. Purchasing the latest technology is not always necessary to a productive operation. There are many factors to consider before deciding to purchase a software upgrade. While many of them may seem obvious, they are so numerous that they are easy to overlook. Since many of the factors associated with upgrades are discovered through practical experience, it is very important to document them. There are no "upgrade" textbooks. This documentation is especially critical with the continuous introduction of new products by software companies. Sharing software upgrade experiences between organizations is a good way to avoid many of the costs and pitfalls involved in the upgrade process. Upgrading can be a costly investment. Organizations must be careful not to let themselves be driven by what is occurring in the market. New technology is not necessarily the best technology.

IMPLEMENTATION AS AN ONGOING PROCESS AND SUCCESS AS A MOVING TARGET

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Implementation generally refers to the initial stage of putting a system in place. With recent developments in database software and the trend toward user independence, it makes sense to view implementation as an ongoing process of review, evaluation, and change. The authors are IS directors at different institutions, running different administrative software packages on the same database system. This paper compares and contrasts approaches to continuous implementation at their respective institutions. Among the topics discussed are the role of the IS director as a facilitator of change, the importance of the steering committee in providing top level support, internal and external users groups, database issues and policies.

The term implementation refers to the initial stage of putting a system in place. It is a very special and exciting time. People are geared up to make an extra effort, there are schedules to follow and milestones to mark progress. Implementation plans are often ambitious and don't account for all the factors that will cause delays. Expectations are high.

Eckerd College and Barry University are independent institutions which both happen to be located in Florida. Each school purchased a different vendor supplied administrative software package and went through a similar implementation. Eckerd College bought AIMS from Axxess in December of 1981, and Barry University installed Datatel's Colleague package in December of 1983. Both software products run on the Prime Information system.

In neither case was there a clear demarcation of the end of this initial implementation phase. What happened, actually was a gradual realization that the implementation was not only incomplete, but also an acknowledgement that things were not exactly as they should be.

At both institutions, we began to evaluate our achievements. We looked at the conversion schedules, and we saw that we had met our objectives in that we had gotten each office on-line. Overall we had been successful. Users now had control of their own data. They were operating on real time and using shared data. A lot of duplication of effort and drudgery had been eliminated. The new systems were much broader than the old batch systems and many new functions had been automated.

We began to realize that things were not really finished, although every office was on-line. The registrar's office was up but was not producing an on-line transcript. Development was using their module as little more than a glorified word processor; although they were processing donations, they still could not get an accurate picture of what the major benefactors had given. Everyone was beginning to wonder when things were going to slow down and get back to normal; after all, the implementation was over.

In retrospect, what happened at both institutions was the result of a combination of factors. First, there were numerous problems and delays in the various areas that resulted in things not being fully implemented. At both institutions we had to deal with mass computer illiteracy, and we encountered a great deal of resistance on the part of some department heads.

Second, the interaction between various offices added a new dimension to the on-line system. Offices that had previously worked separately and independently on the old batch system were now thrown together on an interactive system with shared data. This necessitated system-wide policies and new forms of communication. Administrative offices that are in different divisions of the institution had to learn to function as a unit. Prior to the implementation there was an intellectual awareness that interaction would be important, but the ramifications were not fully understood.

The third and most important factor was that both institutions found themselves on a different level of computing, having gone from batch systems to on-line real time interactive database systems. Users were doing things they never dreamed of on the old batch system. Admissions, for example, had done little more on the old batch system than maintain a name and address file to produce mailing labels; within a short period of time on the database system, they were creating documents and merging data from files. Soon they had developed a full fledged mailing system. In effect, the definition of success had changed.

We realized that the implementation was not finished, but we had lost all our props --- the conversion schedule, the vendor training, the enthusiasm. We began to think that some sort of a re-implementation was in order.

Case History: Eckerd College

Implementation at Eckerd began with vendor support but when the vendor went bankrupt, the task fell on the shoulders of the Computer Center staff. The initial schedule for implementation was changed and valuable time was wasted because the Computer Center staff found themselves having to learn the modules on their own before installing them in the individual departments.

As we moved throughout the campus bringing the database on-line, we began to realize the need for more communication between the users and the Computer Center. Eckerd had an established steering committee, the Computer Policy Group, which was made up of the Vice President/Dean of Faculty, the Vice President of Finance, two appointed faculty members, two appointed students, and the Director of the Computer Center as chair. This committee functioned well when it came to policies but did not meet the communication needs of the database users. An internal users group was formed and anyone utilizing the database was invited to attend. This group met to hear the Computer Center make announcements and dictate rules. Because of the scarcity of decision makers in this group, it was difficult to get priorities in order, or to effect any system-wide policies such as standards for data entry.

In March of 1985, the Computer Policy Group designated a subcommittee to recommend a long range plan for phased computer growth at Eckerd. This subcommittee sent out a survey to ascertain perceived computing needs and a long range plan for computing was designed. Many of the defined computer needs of the campus dealt with the expansion of the administrative software package, and the five items of the long range plan that were critical to this process were:

1. Word Processing
2. Departmental Budget Information
3. Student Information
4. Scheduling of Campus Resources
5. Directory of faculty, staff and student information.

In order to expand the software package to include solutions to the long range plan, the existing database needed some fine tuning. Many modules were not being utilized to their full potential and the users needed further training to produce the results the package was designed to achieve. One area lacking in development on the users' end as well as the training was the query language of the database system.

The first step toward implementing the long range plan was the formation of the database task force. This group was made up of department heads, the decision makers of their individual modules. This task force was intended to complement the internal users group, and its purpose was to form an organized approach to the collection, storage and retrieval of data necessary to produce needed information in a timely manner. We expected to achieve this by analyzing the information flow at Eckerd and how the software package would support it. In particular, we planned to identify various ways in which the software could be utilized to attain goals set forth in the long range computing plan.

The database task force met for the first time in the fall of 1986. It became clear that many of the department heads, the decision makers, had a good understanding of their own individual modules but were lacking knowledge of the system as a whole. To provide this group with an overview of the whole system, the Computer Center held a two day off campus seminar entitled, "Walking through the AIMS System with You." This seminar was an in-depth view of the flow of data through the database and the interaction of the data throughout all modules. This seminar achieved in many ways an interaction between departments that the Computer Center had been internally trying to accomplish for years. During the last two hours of this seminar, we drew up a list of committees to evaluate problems such as name and address standardization and prioritization of master files. Our most significant accomplishment was the designation of responsibilities or ownership of data in the system.

After the seminar, the Computer Center set up intensive all day seminars with the person or persons who worked with the software on a daily basis. The sessions were designed to start at the beginning of the particular module and work through it one menu item at a time. The question we focused on at the seminar was, "How are you using the system and how would you make it better?"

The Computer Center became aware that there was a need for a formal structured way to record requests for changes and designed modification forms to gather information from the module review. The form included the date submitted, the date received, the expected completion date, and a detailed analysis of the problem. Each form had to be signed by the user's department head.

Many of the modifications were fairly easy to do and were not too time consuming; others required further evaluation. It was an eye opener to see how many users were putting up with problems that could have been fixed with a few lines of code or, in some cases, an explanation of a particular feature of the software.

The Computer Center developed an internal database to record all the modification requests. Weekly reports were generated and distributed to the database task force for review. The Computer Center used this modification requests database as a tool in planning the allocation of resources needed to accomplish the modifications as well as a tool in deciding which departments required further training sessions.

Because of the complexity of the query language of the database, the Computer Center set up training sessions in the individual departments. This allowed us to train them on their own files and data elements rather that taking a generic approach. These sessions involved all users in the particular department, and that helped create a feeling of unity in each office.

During the initial implementation phase and throughout the years, the role of the Computer Center has gone from a dictatorship where we set all the rules to a democracy where the users play a major part in the decision making. The Computer Policy Group, the database task force, and the internal users group have come to view the Computer Center as a customer service center where support and training are the primary functions. Although these groups continue to look to the Computer Center for leadership in the field of computing, they have a sense of ownership of the database and they are taking a more active role in decision making.

Case History: Barry University

During the implementation at Barry, we relied heavily on our software vendor for formal training and consulting. We knew that we were dealing with a limited resource, so we used the vendor support wisely. Gradually our staff took on more and more of the training. By the time the vendor training ended, we had a good system of formal training in place. As our knowledge of the software increased, we realized that we no longer needed help from the vendor in working out procedures. We began to conceptualize internal consulting as a function of the Data Center.

While we were developing the idea of internal consulting, the

Vice President for Business Affairs called me in and told me that the university was getting complaints from vendors who were not being paid on time. Recognizing a good opportunity, we jumped in and did what we later called a "module review." We interviewed everyone in Purchasing and Accounts Payable and mapped out what they do on flowcharts. Then we met with the vice president and the department heads over those offices and made recommendations. We agreed on some changes and before long the vendor complaints ceased.

The problems we found in the purchasing/accounts payable area had virtually nothing to do with the computer; they were people problems. People were simply doing things the way they had always done them. On the old batch system, for example, the people who accepted goods had been taught to hold the purchase orders until there was a sizable stack. Continuing to do this on the real time system caused bottlenecks in the accounts payable office.

We also discovered that the people in these two offices did not understand that they could retrieve information they had put into the computer and use it to help them do their work. They were still relying on manual systems to match things up. They were doing their transaction processing on the computer, but the computer was not doing anything for them. A few simple working reports changed that.

The actual changes that resulted from the module review were relatively minor. The flow of the paperwork was improved, some unnecessary tasks were eliminated, and the Data Center designed a few additional reports and put them on a user menu. Most of the work went into the analysis. The results of the module review were long-lasting and well worth the effort. A serious problem was resolved, and everyone involved came out of it feeling good about what they had accomplished. The two offices learned how to get effective support from the Data Center. Since the module review, they have never ceased asking for and getting things from the Data Center, including an inventory application. Once they understood how helpful data retrieval is, they began to take training more seriously. Several people in Purchasing have learned to use the database query language.

That first module review was such a success that we decided to formalize it and make it part of our regular services. We created a Module Review and Evaluation Committee which changes composition according to the area under review. The group includes department heads and key personnel from the offices, Data Center staff, and the vice president of any division involved.

A module review can be initiated by anyone, but normally it is a vice president who does so. The structure of the review varies according to the type of functions that are being reviewed. A review might encompass one function, one or more offices, or an entire division of the university. The length depends on the scope and complexity, and we never undertake more than one module review at a time. Some of the reviews we have done were registration, student addresses, and we are currently doing one for the Institutional Advancement division which includes desktop publishing.

The primary objective of the module review is to step back and take a fresh look at a particular area, to focus as much of our attention on it as we can, and to reevaluate how the system is being used in that area. In the Data Center, we tend to work with bits and pieces of the system. We are constantly besieged by users from various areas asking for additions and enhancements. Almost all of their demands are legitimate, and we are so busy juggling priorities that it is easy to overlook things that may be very important. The module review gives us the opportunity to take an in-depth look at one area and give it the kind of attention it deserves.

At the same time we asked for the creation of the module review committee, we asked for a steering committee. There was a great deal of executive participation during the purchase of the system, but it began to wane as the implementation got underway. The module review insures a certain kind of top level participation, but we also wanted their guidance on long range planning issues such as upgrades and future directions.

The steering committee is composed of the Vice President for Business Affairs, the Vice President and Associate Vice President for Academic Affairs, and the director of the Data Center. The group discusses policies and issues relating to administrative computing. The existence of the steering committee allows the Data Center and the administrative department heads to be proactive in administrative computing, while insuring that what we do is in line with the institutional objectives.

The Administrative Users Group began as a forum for the exchange of information that affected everyone on the system. The early meetings were little more that a series of announcements; they were characterized by enthusiasm, naivete, and physical discomfort. We still meet monthly, but we do it in nicer facilities. We serve coffee and bagels, and the users dish up cynicism. We, the Data Center staff, welcome their cynicism because it is born of experience and is an indication that the earlier naivete has been replaced by a certain level of sophistication concerning the system.

The internal users group was the subject of some reevaluation after the initial implementation. Announcements were supplanted by discussions. The focus turned more to allocation of system resources, testing and installation of new software releases, and refining of system-wide policies and procedures. It became more of a decision making group.

One of the first things we did with the users group after the implementation was devote a long series of monthly meetings to presentations by different offices about what they do. One of the things we were not completely successful with in the initial implementation was the interaction among the different offices. There was a real need to have each office understand what every other office was doing, so that they could empathize with the needs of the other users when we were negotiating procedures.

During the implementation phase, the Data Center dictated many of the policies relating to interaction. The purchasing office wanted to enter vendor information in upper case, but we forced them to do it in lower case because the development office might want to send letters to the vendors. Our gestapo tactics met with some resistance, but they were necessary during that initial stage. We are finding users much more willing to cooperate now that they understand what the other offices do and why. We in the Data Center had a unique vantage point on the system. We saw what each administrative office did, so we understood many things that another office would not. By setting up the individual office presentations, we tried to share that view of the administration. Apparently it was successful, because we now find that the users have more empathy with each other. The less we dictate and the more the users make decisions, the more they own the system.

Our internal users group has always been open to all system users, but now it is primarily attended by department heads and contact persons, or those key personnel who have primary responsibility for the system in their office. We used three of the monthly meetings this summer to define the responsibilites of the contact persons. Next month, we are forgoing the regular meeting for a staff development workshop on shaping change. The evolution of the internal users groups seems to parallel that of the external groups in that we spend less time on technical issues and more on management concerns.

We did a considerable amount of training in the early meetings, but that became unnecessary as we continued to formalize our training. We offer classes and each one has a syllabus. We use our continuing education software with local files to register employees for the classes. We identified various skill levels and related them to classes. We meet periodically with department heads to discuss what training needs they have and target employees for the different levels. The registration allows us to produce progress reports for supervisors.

We are learning to view problems as opportunities for solutions. Defining our role within the institution has been an evolutionary process. We have legitimized our functions of training, support, and internal consulting. The module reviews and our general approach to problem solving have helped our users understand our role. The more they understand our function, the more effectively they use our services.

Compare and contrast what happened at Eckerd and Barry

There are differences between Eckerd and Barry. Barry is larger and has more non-traditional programs. Eckerd had an in-house computer system and Barry was using an outside service bureau prior to purchasing the current systems. The organizational structure of each institution is somewhat different. Administrative computing reports to different vice presidents, and administrative and instructional computing are combined at Eckerd but separate at Barry. We grouped people differently and used different names for them; Eckerd has the AIMS Task Force and Barry, the Module Review committees. These differences, however, are superficial and relatively insignificant in comparison to the similarities in our philosophy and approach.

We have both acknowledged that the system is dynamic. We accept change as a constant that we must live with. There are internal factors that cause change, such as growth, the proliferation of non-traditional programs, the trend toward more effective management, and personnel turnover. There are external factors as well that insure constant change such as trends in financial aid and changing reporting requirements. There are hardware and software changes that come with great regularity. The product life cycle of equipment is shrinking, and our hardware vendors make it prohibitive to maintain old equipment. Both our hardware and software vendors are producing frequent releases of their software. The releases invariably contain features that we need and want. Even if they did not, the vendors force us to stay current by refusing to support older versions of the software. There are other technological changes that open up possibilities that would revolutionize the way we are doing things. Scanners and voice simulation are examples of that type of change.

The other primary factor in the similarity of our approach at the two different institutions is the recognition of the importance of the human component of the system. A system is comprised of hardware, software, and people. And the people element is by far the most important.

Change cannot come about without sponsorship, and we have insured executive involvement by the existence of our steering committees. Change will not be successful unless the people who are affected by it are in favor of it. We have tried to insure that by encouraging user involvement thru the various groups and by promoting user independence. At both institutions, support and training are primary functions of the computer center.

What we have attempted to do, in short, is promote attitudes that are conducive to change and develop a flexible structure that will accomodate constant reevaluation and change. We offer training classes and demonstrations, we advertise successes, we focus on solutions, we try to maintain enthusiasm among our users, and we are constantly developing new tools which make the users more independent.

There is no simple formula for success. The people component insures that the system will always have gray areas and fuzziness. But if people are willing to acknowledge change as a constant and if there is a structure that will support the mechanisms of change, success becomes more likely. We have learned that we cannot effect change without both top level support and user willingness. People will continue to resist change, and we will never be able to sit back, relax and say that we are finished. Implementation is an ongoing process and as long as we view success as a moving target and continue to work at it, we will be successful.

Track V

Communications

Coordinator:
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Communications is the backbone for the integration of technologies on our campuses. Administrators must consider strategies for total electronic integration, networks, and phone systems, with consideration of costs, implementation, and the impacts on campus communication. The papers in this track cover major areas of interest, including voice, data, and video communications.

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New River Community College

Ann von der Lippe
Massachusetts Board of Regents of Higher Education

David P. Redlawsk
Moravian College

UNIVERSITY OF
Miami
A GLOBAL UNIVERSITY

UNIVERSITY OF MIAMI LAN: A CASE STUDY

Ruben Lopez and M. Lewis Temares

UNIVERSITY OF MIAMI LAN: A CASE STUDY

INTRODUCTION

The University of Miami's three (3) major campuses have installed digital telephone switching systems, as follows:

Campus	Location	PBX
Main Campus	Coral Gables	AT&T System 85
Medical Campus	Miami	AT&T System 85
Rosenstiel School of Marine & Atmospheric Sciences (RSMAS)	Virginia Key	ROLM CBX

The three switches were purchased in 1983 and installed in the last quarter of 1984. As part of the cabling task required for the Systems 85,the University had a spare 4-inch conduit installed at the Coral Gables and Medical campuses for future use. The conduit connects the major campus buildings. The University procured and installed a Local Area Network in this conduit and it serves as an inter-building "backbone" network carrying data communications, video and voice signals throughout the Coral Gables campus. The network is not intended for intra-building communications. It is the responsibility of the individual departments occupying each building to select and secure, with central facility staff aid and advice, the intra-building network.

Analyzing the current and anticipated requirements for a LAN on a university campus should include the following considerations:

- A survey of existing computers, data terminals, PBXs, Satellite Earth Stations and High Speed Links (T-1 carrier)
- An estimation of current data communications usage levels, and the future needs, derived from user interviews.
- An analysis of video and voice communications needs.
- An analysis of possible interconnection traffic between the LAN, PBXs and T1 carriers.
- An analysis of LAN alternatives and options.
- Recommendations for LAN requirements.

At the University of Miami we began by examining the organization, existing computer and terminal facilities, data communications traffic and the local area network alternatives in order to arrive at a set of recommendations for implementation. This paper describes this methodology.

Organization

Until November 1986 The Telecommunications Department reported to the Associate Vice President for Business Affairs while computing reported to the Associate Vice President for Information Systems. Today, both departments report to the Associate Vice President for Information Resources. The integration brought about a reorganization of computing and telecommunications by functions. Telecommunications was reorganized into a similar format as Infomation Systems with its selected functions and responsibilities assigned to three directors as follows:

- Information Networks Development
- Telecommunication Operations
- Accounting and Administrative services

The networks development unit is responsible for the development of new telecommunications revenue services for the University. This includes research, analysis, RFP preparations/evaluations and project management throughout the implementation of the new services.

The telecommunications operations unit is fully responsible for the daily critical activities of the Telecommunications unit including voice, data and customer services. There are four voice technicians servicing three (3) PBXs, and approximately 8,850 telephones. In addition, three (3) data technicians support the LAN cable plant, data terminals equipment (ASYNC and SYNC networks), data switching devices, and cable installations. Also, they are responsible for all the network interface units (NIU) installed on the LAN.

The billing and budget controls unit has five (5) people supporting functions such as sub-contractors, carriers, purchasing, internal and external billing problems and budget preparation and control.

The organization model used is a replicate of the structure the University of Miami followed in implementing its Long Range Information Systems Plan (LRISP).

EXISTING COMPUTER AND TERMINAL FACILITIES

As an indication of the present and future extent of data communications on all four (4) campuses, it is useful to review the existing computer and terminal facilities, and the growth projections for the future. With LRISP entering its fourth year, plans for the increase in on-line applications, which will have a direct impact on the volume of communications, must be carefully monitored and projected.

The University's computer center is located on the Coral Gables campus. At present, the major computers used at this location are:

- An IBM 3081-KX, a Univac 1100/82, and a cluster of DECs 8650 and 8530 are the three large mainframe computers, with the VAX cluster primarily used for academic/research computing, and the IBM 3081 and Univac sharing administrative and academic functions. An additional MICROVAX II is dedicated to instructional applications.
- An estimated 125 terminals, work-stations and/or personal computers are now located in the computer center building. The administrative network (SNA) has 1224 workstations and/or personal computers throughout all four (4) campuses and approximatelly 785 workstations and/or personal computers on the Asynchronous network.

There are several distributed departmental host computers networked in four (4) campuses attending specialized applications.

At present, most of the administrative computing applications operate in the on-line mode, while academic applications tend to be more on demand and batch oriented. The University's information system plans project a trend toward more on-line applications in both areas.

The development of on-line administrative applications software, in accordance with the Long Range Information Systems Plan (LRISP), planned procurement of additional DEC and IBM computational power and installation of more scientific and social sciences software, will greatly increase the data communications traffic flow to and from the Computer Center.

The Ungermann-Bass coaxial cable backbone network is viewed as the major vehicle for data communications to and from the Computer Center. With its installation, "private" hard-wire and/or Southern Bell leased data circuits were phased out, together with dedicated computer ports. With the LAN, communications data rates of 9,600 bps or higher are expected to become the standard, although existing lower speed asynchronous dial-up rotary service will be available.

With the LAN available, the data communications capability of the System 85 can be used for remote campus locations not connected to the

LAN because of cost and physical constraints. For occasional dial-up users whose level of use does not justify LAN connection, and for off-campus data communications to national networks or data bases, the System 85 is utilized through a T-1 carrier accessing our Satellite Earth Station at Virginia Key which is linked to the National Science Foundation "super-computers" network.

DATA COMMUNICATIONS TRAFFIC

Current Status

There are approximately 1,000 computer/terminal devices on the Coral Gables campus at present. If all of these devices were to communicate simultaneously over the same LAN (admittedly a worst-case scenario), the LAN "throughput" requirements would be as follows:

Average Data Rate per Terminal (1000 Terminals)	LAN Throughput
1,200 BPS	1,200,000 BPS
2,400 BPS	2,400,000 BPS
4,800 BPS	4,800,000 BPS
9,600 BPS	9,600,000 BPS
19,200 BPS	19,200,000 BPS

All of these, taken together, may reduce the LAN throughput requirements by an order of magnitude. Nevertheless, the worst-case calculations are useful in establishing upper ceilings for data communications.

Any estimate of future data communications traffic on the backbone LAN must necessarily be considered as valid only to an order of magnitude, since the traffic will be affected by a number of factors, many of which remain yet to be defined.

Among these are:

- The actual (rather than projected) growth of terminals and PC's on the campus.
- The rate of completion of on-line Computer Center applications programs.
- The upgrading of Computer Center facilities.
- The installation of departmental LAN's to localize some data traffic.
- Implementation of the Residential colleges and residence halls wiring plan to the "backbone".

Because of these uncertainties, and the rapid growth of dataprocessing facilities mentioned above, it is prudent to use estimates on the high side rather than the low side.

Topology and Data Rate

The LAN uses two (2) distint topologies a Star and Bus configurations with the Computer Center as the central node.

Assuming that one-third of the aforementioned devices (1000 terminals) might be communicating to the Computer Center at the same time on a single spoke of the LAN star, and also assuming that the average data communications rate is the 9,600 BPS that the Computer Center would like as a standard, the total data rate on that spoke would be:

330 x 9,600 = 3,168,000 BPS

With this assumption, a 3.2 MBPS throughput rate would be needed on that data path. More terminals or a higher average data rate per device would require a proportionately greater throughput rate.

The data rate per star path could be reduced by making more nodes and paths available, with a smaller number of devices connected to each node. This, however, requires more concentrators and node interface equipment, and therefore increases the cost of both hardware and cable.

LOCAL AREA NETWORK ALTERNATIVES

In order to specify a LAN which best meets the University's present and future data needs, an understanding of the alternatives is required.

There are a number of basic parameters which define a LAN, including the following:

- Physical Configuration or "Topology"
  - Bus
  - Ring
  - Star
- Transmission Medium
  - Twisted-pair
  - Coaxial Cable
  - Fiber Optics
- Transmission Mode
  - Baseband
  - Broadband
- Network Access/Control Method
  - Collision Avoidance
  - Token-Passing

In addition to such fundamental characteristics, a number of secondary LAN features also are very important, including:

- "Throughput rate," or how much information can pass through the network in a given time.

- Reliability, both of the medium itself and all of the necessary interface and ancillary devices.
- Flexibility and Modularity, or the capability to adapt both to future growth and changes in traffic requirements, without costly modifications.
- Cost, both initially and over the anticipated life cycle of the network.
- Comparability, with non-data communications requirements, such as video and voice traffic.
- Network Management capability, or the availability of equipment and procedures that facilitate the maintenance of the LAN.

At the lowest level, the University's backbone LAN can be viewed as just a passive distribution medium. No formatting, packeting or conversion of data would be supplied as part of the network. At the other extreme, the backbone LAN would be a complete networking system, providing, in addition to distribution paths, such functions as:

- Interface capability for all computer and terminal devices.

- Concentration and/or multiplexing of groups of devices at network nodes.

- Formatting and packeting of data at nodes.

- Establishing network access procedures, and controlling traffic flow, particularly for high-volume transactions such as file transfer.

- Converting protocols, both internally on the LAN and for interconnection to other LAN's or gateways to national and international networks.

The University preferred the maximum in LAN capability,i.e., the highest-level extreme. Practically, the cost of complete "universality," generally will dictate some reduction from the maximum. For example, the interface capability for all computer and terminal devices and the degree of protocol conversion may be limited to support of some finite number of types, rather than all.

A brief summary of the foregoing alternatives can be stated as follows:

- For the University's existing computer structure, a star topology with the Computer Center as the central node appears desirable. Emerging trends, however, such as the rapid growth of PC's on the campus, might indicate a need for a supplemental LAN with a ring or bus topology.
- The projected volume of data communications appears to indicate a need for more throughput capacity than can be provided by a single baseband LAN. A broadband LAN, or both a baseband and broadband, might be the solution.
- A broadband LAN could also accommodate video communications, including commercial CATV services and academic video programming. Alternatively, a separate coaxial cable for video could be installed along with a data LAN.
- A broadband LAN can provide lower data error rates than a baseband.
- If a broadband LAN is desired, fiber optics are not competitive at this time. For a baseband LAN, fiber optics and coaxial cable each have specific advantages and disadvantages.
- The cost of a broadband LAN is higher than a baseband type for the same number of nodes and terminal connections, because of the need for radio frequency (RF) data modems to place data signals on individually dedicated carrier frequencies.
- The cost of optional LAN features may dictate the establishment of several levels of requirements for the selection of a vendor, so that a cost-versus-capability tradeoff can be made.

RECOMMENDATIONS

The University's Committee overseeing the backbone LAN procurement made the following recommendations:

(1) The alternatives should be limited to a broadband LAN providing capacity for both video and data communications, or;
(2) A baseband LAN for the primary data mode, combined with a broadband secondary network for video communications, overflow and/or future data traffic.

If option one (1) above were selected, then coaxial cable should be the transmission medium. If option (2) were selected, vendors should be permitted to propose either fiber optics or coaxial cable as the medium for the baseband LAN, and coaxial cable for the secondary network.

Whichever option was selected, terminations should be made at each University building passed by the conduit permiting transmission and reception of both data and video. This implies bidirectional capability for both communication modes.

IMPLEMENTATION

A request for proposal was issued to different vendors for a Local Area Network to be installed in the empty conduit, and to serve as a "backbone" network for three types of communications:

- Data Communications between buildings.
- Video Communications between buildings.
- CATV service to the Residence Halls, and designated other locations.

After an evaluation was performed with the aid of an outside consultant, the vendor selected was Ungermann-Bass Inc..

- They proposed two separate networks:
  (1) Data/Video Networks--- Coaxial cable, broadband, with five two-way channels assigned for data communications. This same cable will provide 20 bidirectional video channels for instructional and academic purposes. Ungermann-Bass installed all amplifiers, power supplies, cable, passive devices, status monitoring equipment and headend equipment to provide a fully operational network connection for both data and video communications. It will connect to a designated location no more than 50 feet from each building.

  (2) CATV Network--- Coaxial cable, designated to provide up to 54 channels of CATV service and FM to all Residence Halls and other designated locations.

Problems encountered at installation included:

(1) Initial design and installation schedule was not correct and additional nodes and amplifiers were required.

(2) It was desirable to remove the CATV network from the negotiations with Ungermann-Bass and award it to Dynamic Cablevision to provide CATV service to the campus, without cost to the University.

HIGH SPEED LINK TO MULTI-CAMPUSES

The RSMAS campus has been linked, via a satellite transmit/receive earth station, to a National Science Foundation network. Researchers on the Coral Gables and Medical campuses were interested in also obtaining access to the NSF network. Thus, we purchased T-1 links to both Medical and RSMAS campuses. These links will be utilized for at least three (3) purposes:

- To permit users on the Coral Gables and Medical Campuses to share access to the NSF network link at RSMAS.
- To interconnect the Medical and RSMAS campuses to the major data processing facilities at the Coral Gables campus, for administrative on-line applications and other data communications.
- To reduce the cost of tie-lines and data circuits presently leased from the telephone company, and possibly also to consolidate some Direct Inward Dialing/Direct Outward Dialing trunk groups now being used for each campus PBX.

The original request for proposal included the T-1 link only. The terminal equipment combining the various signals at each campus into the T-1 data stream was to be procured separately. One of the options contemplated by management was a microwave link between the Coral Gables campus and RSMAS, and between the Coral Gables campus and Medical campus as one of the most effective transmission medium. Therefore, the requirements and performance of the request had a few restrictions allowing the vendors to propose other approaches.

The evaluation criteria took into consideration the following items:

- Experience: technical and financial capability of the vendor and major subcontractor.
- Cost, including:
    - initial installation cost
    - estimated lifed-cycle cost
    - cost of spare parts and maintenance
    - estimated additional costs to the University
    - estimated cost of future expansion
    - installation schedule

In order to properly ascertain the best alternative, we took into account planned growth at all campuses and using economic judgment as to which represents the lower cost, while providing full functionality to the University. In addition we took the fast evolution of technology into consideration such as ISDN.

LESSON LEARNED

The integration of voice and data has been confusing, frustrating, difficult to manage, but critical to our future. The diversified backgrounds among technical disciplines required budgetary salary adjustments, new job descriptions and organizational structures changes. The most interesting area is in the development of a common management approach to all of these vital assets. The greatest achievements will be in those institutions which use common systems management techniques across both data and voice networks.

The major management lessons we learned were:

1. Its harder to run a Telecommunications department than you think.
2. Skilled personnel understanding voice and data are virtually non-existent at any cost.
3. Telecommunications organization in universities are generally "order takers" and "service facilitators, not technologically knowledgable.
4. Telecommunications management is in its infancy, comparable to computer centers of the 1960's.
5. Rapid changes in technology demand as flexible a structure as information systems.

Neither business nor our institutions could get along without the collection and distribution of information through electronic networks. Our students and business executives call themselves "computer involved". This new wave must also be knowledgeable about telecommunications and become "communications involved".

DESIGNING AND IMPLEMENTING AN INTEGRATED COMMUNICATIONS ENVIRONMENT IN A SMALL COLLEGE

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New River Community College has installed an integrated, state-of-the-art communications system which links voice, local area networks, asynchronous data, and synchronous data into a single campus-wide communications network. Access is provided in each office via standard phone jacks through a common cable system to voice phones, multiple local area networks, and multiple paths to an off-campus mainframe network. Topics discussed include planning strategies, dealing with state purchasing offices and vendors, supervising installation, cost analysis, system management, benefits and potentials of an integrated system, and applications for an improved data environment.

Designing and Implementing An Integrated Communications Environment In A Small College

New River Community College, a two-year college located in the beautiful mountains of Southwest Virginia, is part of the Virginia Community College System. With an enrollment of approximately 1800 FTE, it ranks among the larger of the small colleges in the system. The college is located within 25 miles of two major state universities: Radford University and Virginia Polytechnic Institute and State University.

Even though New River is among the state's smaller community colleges, it has a reputation as a leader in both educational and administrative use of technology. New River's programs in Process Instrumentation and Electronics Technology have an international reputation for excellence. In addition, a number of important management information systems developed at New River are now in use across the entire 23-college system. These include the Productivity Analysis System (PAS), the Generalized Accounting Reporting System (GARS), and major contributions to the on-line Student Information System (SIS).

Almost two years ago, New River began construction of a new building on campus. This construction necessitated a plan for providing telephone and data communications services to the new building. Rather than view this planning in its narrowest perspective of only providing service to the new building, the Dean of Management Services directed his staff to explore the state-of-the-art technology, the trends, and their cost, with the idea of providing a new communications environment for the entire college. The potential benefits to the college from this approach became evident early in the study. Throughout the process of study, design, acquisition, installation, and the use of the system, the benefits and potential have continued to grow.

The integrated communications environment provides the college a state-of-the-art system with the flexibility to provide to each user in the college the level of communication services required, whether this be a simple voice-only telephone, a personal computer tied into the local area network, access to the state mainframe network, or all of these services integrated into a single workstation. Indeed, this "workstation" concept has been the planning focal point for the system design. Using this concept, each individual at the college, whether student, faculty, staff, or administrator, is provided the level of service required by simply plugging the necessary equipment into standard phone jacks located throughout the college.

Understandably, New River is far from 100 percent implementation of this system, but the communications backbone is in place. Expanding to 100 percent implementation will require only the purchase of the equipment for each workstation, resulting in relatively low workstation-by-workstation expenditures since the big expense of the communication backbone has already been made.

One of the key elements of the college's integrated communications environment is the Local Area Network (LAN). Prior to the implementation of the new system, New River had two computing environments. As part of the state community college system, New River has terminals and printers tied into the state IBM mainframe network consisting of nine IBM mainframe computers located in five centers throughout the state. For data and/or processing intensive applications, such as the Student Information System, the college uses leased telephone lines to access this network. In addition to the mainframe network, many college offices and student labs have been equipped with personal computers (PCs). These PCs are used extensively for word processing, electronic spreadsheets, and locally developed data base applications. However, the college had a number of applications where data bases needed to be shared or where expensive resources were needed but could not be justified for a single user. These applications which are not cost effective on the mainframe are appropriate for a PC, particularly when resources can be shared. A LAN provides the interconnection vehicle for capturing the full power of the PCs on campus. Applications requiring shared data or shared resources are implemented over the LAN.

The design of an integrated communications network requires the careful selection of every aspect of the actual hardware to be installed. (See Figure 1 at the end of this report for an overall design of the system.) In wiring alone, one must decide on the type and number of jacks, whether to use twisted pair, coax, fiber, or a combination. New River chose to replace its entire cable plant, which had consisted of a mix of coax and old telephone wire. Each current or planned location with a phone or data connection was provided with dual eight-pin modular phone-style jacks. These jacks were connected to intermediate distribution frames with two unshielded, twisted-pair cables, each containing four pairs. For voice communications, the buildings were interconnected with 200- and 400-pair copper cable. Some of the inter-building data also use the copper twisted pair cable. For LAN and asynchronous data between buildings, multi-strand fiber-optic cable was installed.

The LAN chosen was AT&T StarLan, a one-megabit-per-second LAN capable of transmitting relatively long distances over standard twisted pair cable. At present, the AT&T StarLan software is used on the network, but the StarLan hardware will support a number of LAN operating systems, and an academic computer lab will be networked soon using the NOVELL operating system on the StarLan hardware. While the data transmission rate of the LAN is important, New River's research and experience have shown that the speed of the workstation and servers affects performance more than the LAN speed above one megabit per second. Along with speed, reliability is a critical factor in deciding which LAN to install. Most LAN vendors now advertise that their LANs work on standard twisted pair, some at up to ten megabits per second. However, the college's research indicated that only StarLan could reliably work over distances of around 800 feet without shielded twisted pair, and/or placing repeaters or extension units throughout every building on campus. With StarLan, New River has reliable LAN access from anywhere on campus, with all LAN connections in a building coming back to a single location within that building.

At New River, all voice communications are provided with a mix of digital and standard analog touch-tone phones connected to an AT&T System 75 on-premise PBX (Private Business Exchange). This all-electronic switch is typical of modern PBXs and allows the college to expand from its current 225 phones to 800 phones. With the System 75, college personnel are able to do all moves of phone equipment and to make changes of access and features. The "75" provides "call detail reporting" of all incoming and outgoing calls and logs them on a college microcomputer for use in traffic, service, and cost analyses.

The LAN and asynchronous data are connected to an AT&T Information Systems Network (ISN) packet controller for inter-building communications. While the System 75 has some data switching capability, the ISN allows the expansion of the StarLan network to thousands of PCs at any location on campus while maintaining a single logical network. The ISN also provides connection to an AT&T protocol converter from any building so that asynchronous terminals and PCs can access the state-wide mainframe network.

Besides the protocol converter, the college has other terminal and printer links to the state mainframe network. The two existing 3274-type control units have been converted to use twisted pair instead of coax by the use of coax-to-twisted-pair adapters. Now IBM 3278-type terminals can be moved as easily as telephones by plugging them into the same jacks as all other devices instead of running new coax.

Additionally, the college has installed a gateway on the LAN, which allows any computer on the LAN to access the mainframe network and emulate a 3278-type terminal. This through-the-LAN access replaces the dedicated terminal emulator board placed in the computer and gives the added advantage of having one machine which can be used as a stand-alone PC, as part of the local area network, and for access to the mainframe network. Since a telephone can also be plugged into the LAN board in the computer, it is possible to place all communications and computing services on a person's desk in one machine.

New River's solution is, at present, primarily a one vendor solution. This is partly by design and partly a function of the state purchasing procedures. After the planning was completed, a Request for Proposal (RFP) was prepared by the college. This RFP focused on the environment and function desired rather than on particular equipment. With the technology advancing so rapidly, the objective was to deliver an RFP delineating college requirements, while allowing the vendors the flexibility to propose their state-of-the-art solution. Since the desire was for an integrated solution which allowed for long-term growth, the decision was made to require vendors to propose solutions in which the vendor would provide, and commit to support, all equipment. By requiring the vendor to support all of the equipment, problems of blame shifting as any malfunctions arose were eliminated.

The college protected itself from being tied to one vendor completely in the future and from having an orphan system by following established standards (i.e., IEEE, NETBIOS, etc.). Therefore, the college effectively has a solution which can be multi-vendor in the future, but which will have a single vendor responsible for assuring the installation and operation of the core of the system.

Cost factors were an important consideration in the design of the integrated communication system. As Figure 2 shows (see end of this report), New River discovered that this integrated solution could actually be less expensive over a five-year period than continuing with the "traditional" disjointed, unintegrated approach. By assuming the responsibility for managing its own voice and data communications, the college was able to recover the cost of the system in fewer than five years. Actually the payback period is even less than shown because the comparisons in Figure 2 are for a voice-only solution (Centrex, the now predominant solution in the state). Had this solution been chosen, the college would have had the additional expense of providing data service to the new building and finding solutions to many applications which would make use of a LAN. Furthermore, there would have been the additional expense of providing improved access to the mainframe network.

New River was able to consider a state-of-the-art communication system because of a strategic opportunity. A new building was being built which required both voice and data communications and for which capital funds were available. Because the old phone system was expanded to its maximum capability, a new system was required just to meet the voice needs. As indicated previously, the currently "recommended" solution for phone systems in Virginia is Centrex. Since Centrex was bid as one response to the RFP, New River had cost figures to use for comparing a system with up-front cost, as opposed to one with continuing cost (Centrex). As it turned out, the system with the up-front cost was cheaper over a reasonable period of time (five years) and provided all the functions the college desired. However, without the capital to implement the choice, New River may not have been able to have the integrated environment.

As part of making the system cost effective, New River must be able to manage it. Actually the new system makes manageability easier and often less expensive than the unintegrated solution. Multiple paths to the mainframe have doubled the number of users possible with no additional leased line charges and at a cost substantially below the cost of purchasing control units and running coax. Resources such as hard disk and laser printers can now be shared and become cost effective solutions. Because of the close integration of the system, the college can now use laser printers to print output from the mainframe computers while providing laser printer service to PCs.

The call record data provided by the System 75 PBX allows the college to provide phone costs and traffic data to departmental managers. These data are very critical in making cost effective decisions about types of outside phone services; however, the college is careful to avoid a "big brother" atmosphere by treating the data as management information and allowing managers to use it within the general guidelines required by law.

Throughout the procurement process, New River had to educate a number of people that "just a phone system" was not the solution. Coupled with their need for an understanding of the technology involved was the purchasing agency's mandate to control cost. Even though substantial cost reductions were made through negotiation, the vendor receiving the final award was in the beginning the fourth lowest.

How then does one get a workable solution? One must have on staff, or as a consultant, one or more people who can read the actual technical specifications of the vendors' equipment and compare them with the desired function. Without a careful, line-by-line scrutiny of vendor specifications, New River could have settled for a less than complete or even an inoperable solution. Only one of the five vendors bid a system which met the college's specifications: the AT&T system now installed.

Once the award was made, attention was then directed to the installation. During the installation there are two points that were observed. The first was to make sure that the installation met the necessary fire, structure, and electrical codes. This includes little things, like the type of insulation on the cable jacket, to big things like floor loads and electrical hookups. For institutions following a similar procedure, if a separate inspector were available for this work, then he should be given a free hand to make sure the installation complies with the codes. Otherwise, someone in the institution must provide this overview.

In the case of performance criteria, one simple rule was followed by the college--"make sure it works before it is paid for." One piece of $10,000 equipment was finally removed and returned after the vendor spent six weeks trying to make it operable and finally determining that it never would work in New River's environment. The college also tried to run everything as much and in as many ways as possible. When the PBX was cut over, a problem in its operating software allowed a user to accidentally tie two long distance lines together if a busy signal was reached twice in a row.

Knowledgeable college personnel are critical to implementing state-of-the-art technology. These personnel will be of little use without an effective management structure. At New River, the Dean of Management Services had overall responsibility for initiating and managing the planning, purchase, installation, and use of the system. The actual day-to-day work was handled by personnel in the Computing Services Department (Communications has since been added to the name of this department). This includes installation of equipment and making changes in the phone system. A new person is being added to the Computing and Communications Department staff to handle most of the maintenance tasks. At present, the system is still under warranty, so much of the real maintenance is handled by the vendor. When the warranty year is up, the college plans to add a few critical components to maintenance contracts and have college personnel do the rest.

A computing and communication master plan is being developed to identify the applications and areas which can be served in the future. This plan will encompass every area of the college; therefore, an important step in this process will be to set priorities. As stated earlier, New River's integrated communications environment provides only the backbone. Many PCs remain to be brought into the LAN, and even though the access to the mainframe network is greatly expanded, it is not unlimited, so planning is important. In addition, the plan must have backing at the highest levels. Lower level support and supervision are necessary to make sure that data integrity is maintained and that resources are not abused. As with any new technology, training and education of users are also important.

As the college becomes oriented to the integrated communication system, it is finding varied uses for it. The first application brought up on the LAN was a package for the college Educational Foundation which provides the members of the staff access to a common data base for accounting and donor record keeping. The college will also be able to use a desktop publishing system which will give various areas of the college access over the LAN to laser printers and the software. Having desktop publishing on the LAN will allow the Word Processing Center staff, the Graphic Artist, and the Information Officer to work more easily together in preparing college publications.

While accounting for the college's state funds is handled on the mainframe system, a major effort is currently underway to automate the accounting of the funds received from local governments, grants, and federal financial aid. As with the Educational Foundation office, the LAN will allow a number of personnel to have access to a common data base and common software.

Additionally, an automated library system is planned where LAN workstations will replace the card catalog, and the catalog will be accessible over the LAN throughout the college and possibly even over the phone to the local community.

As resources become available, the academic PC labs will be placed on a LAN and joined over the LAN to PCs in the offices of the faculty teaching in various labs. This will eliminate the mechanical printer-sharing switches, allow instructors to download data to the LAN instead of making numerous copies, and allow instructors and students to exchange messages over the LAN.

While the new communications system does not change the applications on the mainframe, it does provide increased access. In the future, the college on-line registration will be extended to off-campus locations by dialing into the ISN and protocol converter. Faculty will have access to student records over terminals or computers in their offices to assist with advising.

With devices on the LAN which enable communication with the mainframe, other areas of application become possible. Printouts of reports generated on the mainframe can now be printed on the laser printers on the LAN. This is very useful for reports which are to be bound or which otherwise require high quality print. Other possibilities include downloading a "snapshot" copy of the student data base for local analysis, reducing the load on the mainframe and removing concern about data integrity. Another application being considered is an automated purchasing system which would allow requisitions to be prepared on a PC, moved over the LAN to the business office, and then communicated to the state system on the mainframe.

As a result of careful planning, and with much hard work, New River now has an integrated communications environment which provides for an almost unlimited range of computing and communications options and applications. However, none of what New River has done would have been possible had the college not had a number of technically astute and experienced staff members to handle the technical details. At many stages--from planning to implementing the system--had it not been for knowledgeable staff members, New River could have purchased a system which did not meet its needs, at best, or didn't work, at worst. A recent article in PC WEEK sums up the importance of personnel regarding LANs, but what it says applies equally to the whole communications solution.

> LAN-management skills cannot be developed at home in one's spare time. They require an understanding of integrated computer systems, a work group focus, an understanding of business, technical depth, dedication and more.
>
> Your choice of a LAN manager will mold the shape and character of your LAN, since its long-term value to your organization will be based on the LAN manager's software selections, installation techniques, maintenance, training, service, and development work.[1]

It seems that New River has been able to incorporate all the prime ingredients which will enable the college to make full use of the wide range of communications and computing equipment on campus now, as well as to take advantage of new equipment and technology of the future.

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[1] Del Jones, "Get the Best Value from Your LAN With These 10 Rules for Making a Buy," PC Week, 25 August 1987, p. C/37.

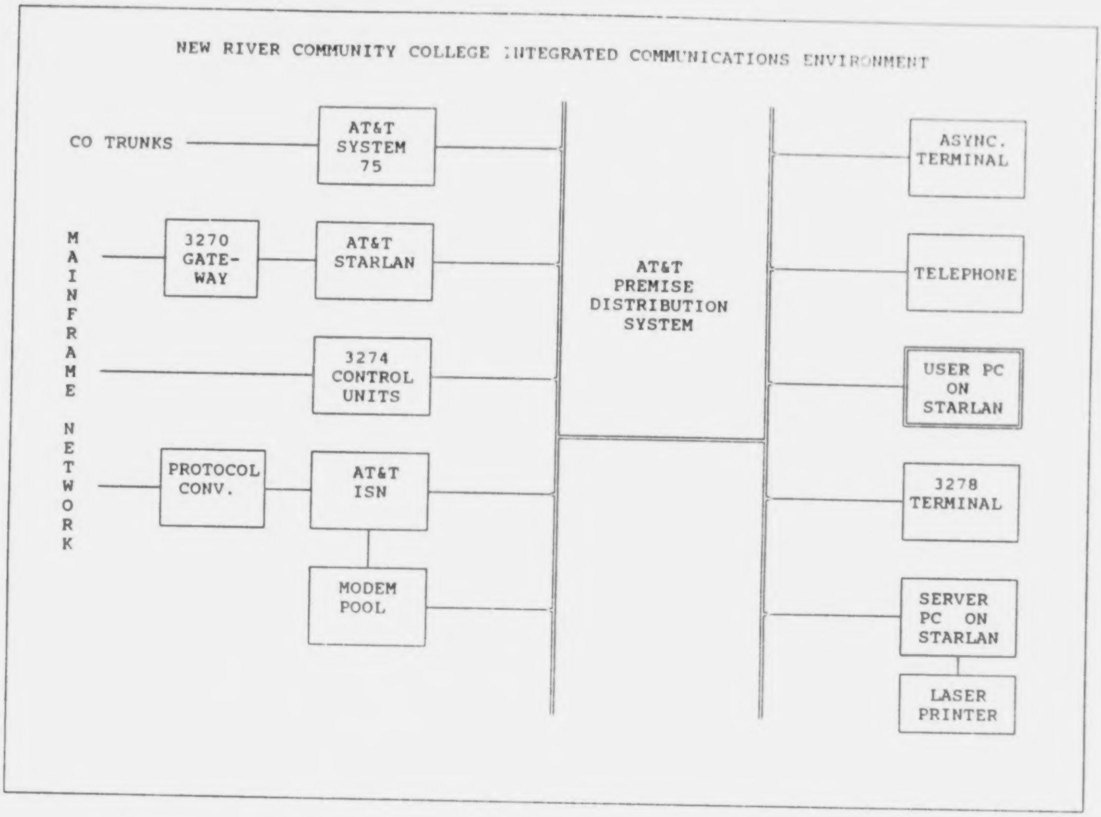
NEW RIVER COMMUNITY COLLEGE INTEGRATED COMMUNICATIONS ENVIRONMENT
CO TRUNKS
AT&T SYSTEM 75
MAINFRAME NETWORK
3270 GATE-WAY
AT&T STARLAN
3274 CONTROL UNITS
PROTOCOL CONV.
AT&T ISN
MODEM POOL
AT&T PREMISE DISTRIBUTION SYSTEM
ASYNC. TERMINAL
TELEPHONE
USER PC ON STARLAN
3278 TERMINAL
SERVER PC ON STARLAN
LASER PRINTER

Figure 1

COST OPPORTUNITY

	VOICE ALL BLDGS	DATA ALL BLDGS	CHARGES FOR MOVES & CHANGES	INITIAL COST	ANNUAL COST	5-YEAR COST
OLD PBX	NO	NO	YES	--	$29,115	$145,575
CENTREX	YES	NO	YES	$176,502	$60,300	$478,002
NRCC'S INTEGRATED SYSTEM	YES	YES	NO	$292,000	$8,000	$332,000

* DOES NOT INCLUDE SCATS, TRUNK CHARGES, AND OTHER COST COMMON TO ALL ALTERNATIVES.

Figure 2

COMMONWEALTH OF MASSACHUSETTS
HIGHER EDUCATION COMMUNICATIONS NETWORK
A CASE STUDY

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ABSTRACT

The Higher Educational Communications Network (HECN) was implemented in June, 1987 for use by the 29 campuses of the public higher education institutions and the Board of Regents for the Commonwealth of Massachusetts. It is a private, statewide, packet-switched, X.25 network providing access from each campus to any other campus, the Regents Computer Network, and the state's data center. The evolution of the network from conceptual requirements through identification of alternatives and topological design to implementation and day-to-day management is discussed. The current performance is analyzed and future possibilities for enhancement are presented.

THE REGENTS COMPUTER NETWORK

THE BOARD OF REGENTS OF HIGHER EDUCATION

The Board of Regents of Higher Education of the Commonwealth of Massachusetts oversees the twenty-nine public college campuses which enroll more than 170,000 students and employ more than 14,000 faculty and staff. Its mission is to provide access to excellence in public education.

THE REGENTS COMPUTER NETWORK

The Regents Computer Network (RCN) is a central computing resource which provides computer and communications services and support to the Board of Regents of Higher Education and the 29 campuses of public higher eduction in the Commonwealth of Massachusetts. The Regents Computer Network reports to the Board of Regents and is located in Boston. It was established in 1973 by the Massachusetts State College Board to provide academic and administrative computing for the 11 state colleges. The Board of Regents was established in 1981 and assumed the responsibilities of the Massachusetts State College Board and its computer network.

HIGHER EDUCATION COMMUNICATIONS NETWORK

In the spring of 1985, the Commonwealth of Massachusetts mandated that the Board of Regents should acquire and implement a centralized payroll/personnel system for all of public higher education. In November 1986, the Board decided that the system would be run at the Regents Computer Network, that facilities would be provided to support the application there and that the RCN's communications capabilities would be expanded to connect all of the 29 affected campuses. The Regents Computer Network computing resources consisted of three CDC Cyber mainframes with associated storage and I/O devices. These mainframes were connected to the state college campuses and to two of the community colleges through a point-to-point circuit network which provided 9600 bps support directly from the campuses to the RCN in Boston.

While definition of the Payroll/Personnel System was delayed, the Commonwealth implemented a statewide accounting system (MMARS). The Board and the Commonwealth determined that the higher education institutions should utilize MMARS. Security and control made it attractive to have only the RCN directly connected to the Commonwealth's Office of Management Information Systems (OMIS) mainframes rather than each of the campuses. The campuses would hence be connected to the OMIS mainframes via an expanded data network, the Higher Education Communications Network (HECN), which linked campuses to the RCN to OMIS. These connections were scheduled to go "on-line" July 1, 1987. GKA was therefore asked to conceptualize network solutions, create appropriate specifications and assist in the procurement of HECN.

NETWORK REQUIREMENTS

The constraints applied to the design and specification of the Higher Education Communications Network were that it must:

1) Connect each of the 29 statewide campus units with the RCN data center.
2) Provide an IBM synchronous (SDLC) gateway (through the RCN) to OMIS for each campus unit which can support direct inquiry, updating and reporting of the data bases for central accounting and the data processing inventory.
3) Provide for academic and administrative processing capability even in the event of circuit failure.
4) Support the initial payroll/personnel system, the MMARS access, current academic and administrative applications, and accommodate new applications such as electronic mail.
5) Provide campus to campus connections for all campuses.
6) Be flexible enough to support connections with the different academic and administrative computers and protocols now in use and those likely to come into use in the future at the schools, the RCN and OMIS.
7) Accommodate a five-fold growth in applications traffic.
8) Provide a grade of service such that the transmissions associated with critical procedures like payroll can be handled for all campuses in a single day from data entry to check printing.
9) Preserve or improve the current user response time.
10) Employ a technology which will make the most efficient use of circuits, thereby minimizing the month-to-month operating cost of the network.
11) Incorporate provisions to assure access security for the Network.

12) Support error correction or mechanism to achieve a low native error rate to assure the integrity of all transferred information.

13) Carry all traffic between the 413 transport area (LATA) and the 617 LATA over T-1 circuitry.

14) Provide a gateway to the various public networks.

15) Include provision for automated network monitoring.

16) Permit phased implementation of the network.

17) Limit the capital cost of HECN to $650,000 in capital outlay.

DESIGN ALTERNATIVES

TECHNOLOGY

Voice and Data Integration

Higher education in Massachusetts would appear to be a strong candidate for the integration of voice, data, and even video. Four factors limit the potential for such integration: 1) T1 tariffs in Massachusetts are relatively high, requiring a high occupancy for cost justification, 2) inter-campus calls are a small proportion of the overall long distance traffic, 3) the largest campus has its own TI from Amherst to Boston and 4) the current prospect for inter-campus video transmission is even more limited.

Experience in other states suggested that the breakeven point for state-wide integration of communications required a broader base of traffic than just higher education (for instance all state agencies). The conclusion in Massachusetts was that integrated or shared voice and data networks were economically feasible only for the few locations with large enrollments and heavy student traffic; most campuses cannot justify T1 interconnections without combining additional state government traffic to and from the campus community. No mechanism exists to sponsor or force the latter option so the integration of voice and data was not initially a feature of HECN. It remains a viable evolutionary path for the future and its use requires no change in the network technology that was adopted.

Multiple Single Protocol Connectivity

The typical data network supports a single protocol and transmission rate. With the varied set of academic and administrative computers on the campuses in Massachusetts (Digital Equipment Corporation, Data General, Wang, Control Data, Prime, Burroughs, AT&T and IBM) to be interfaced to HECN, a diverse set of circuits and protocols could have been required. The addition of gateways to campus local area networks would only have complicated this picture.

The multiple single protocol approach would have led to a network of overlapping and incompatible circuits most of which would require individualized special handling before their transmissions could be passed on to any single or central computing facility--OMIS, the RCN, etc. This approach was avoided because it is extremely expensive for a network of low volume connections. The use of many circuits with differing protocols also sharply increases the opportunities for system failures and the difficulties of providing backup recovery facilities and procedures.

Mixed Protocol Connectivity

X.25 packet switching was selected as the most viable standard for addressing the problems of mixing protocols and line speeds over a common carrier. This standard provides a clear recipe for interfacing different individual vendor standards or protocols and is a mature technology which has been in use for more than twenty years in this country and abroad. The X.25 standard also provides for a circuit switching capability which can often be advantageously employed to balance loading and ensure connectivity when circuits fail by rerouting traffic. The X.25 packet scheme also provides a high level of error detection and correction and an exceptional efficiency in its circuit utilization (typically 80% versus 65% for binary synchronous links and 35% for asynchronous links). The use of packet switching appeared feasible for HECN and met the design criteria as well.

Other Alternatives

The alternatives to X.25 or a similar packetized approach included adopting one of the synchronous or asynchronous standards and utilizing specialized equipment on the campus to handle all protocol and speed conversions before passing the traffic to and from the RCN as a single protocol. Such a strategy again is quite expensive and introduces a relatively large number of different vendors into the network support and maintenance equation.

Another alternative receiving increased attention today is the use of small aperture satellite antennas (VSATs). This alternative has a high natural bandwidth (up to 256KBPS), can be full duplex, and can handle broadcast video, data communications, and even a limited amount of voice traffic. VSAT networks do require the use of a large (and expensive) central site antenna and transponder "space" on the satellite. However, this approach has the advantage of freeing the user from the escalating cost of leased lines and limiting the impact of equipment failures to a single site in most cases. Unfortunately, the economic breakeven point for such a network compared to a leased line network is between 75 and 100 remote locations (but this figure continues to fall).

It was therefore determined to build the network with a network backbone employing X.25 packet switching. This choice allows mixing a dedicated network with switched public services and even transmittal over a satellite network in the future.

NETWORK TRAFFIC

Having adopted a technology, a set of locations to be served and a set of design criteria, the topology and the bandwidth requirements can be determined. Tabulations at the RCN yielded information about the total volume of traffic from existing academic and administrative RCN users, the time they were connected to the network, and the maximum hourly rate at which this traffic was transmitted. While it was not possible to predict the actual traffic which would result from the Payroll/Personnel System or use of MMARS, working estimates were derived. These were averaged to compensate for local variance.

The bandwidth requirements were developed from the observation that data entry personnel average about one character entered per second (CPS) in an interactive environment (in this situation one character is entered for every three or four that are sent back from the computer). Using a fast entry rate of 2 cps, the campus staff size and sufficient entry stations to process all work for payroll, etc. in a day, one may conservatively calculate the average required bandwidth for each campus for the Payroll/Personnel System and MMARS transactions. These figures were then used to estimate the bandwidth and entry time required by each school. The figures were increased five-fold to compensate for growth and future applications.

The estimated bandwidths obtained were such that both current and future applications could be combined on a single, new network without degrading the user response time. The traffic for these applications combined were therefore used to size the circuits for the new network. The feasibility of combining old and new traffic on the new network allowed a portion of the older network equipment to be reused, thus limiting the capital outlay necessary to implement HECN.

NETWORK TOPOLOGY

The requirement to use T-1 transport between the 413 LATA and the 617 LATA meant that all existing circuits in the western portion of the state had to be re-engineered because the then current circuits connected directly to Boston (and were thus quite expensive). The most direct solution was to link each school to one of the existing T-1 end points in Springfield or Amherst using point-to-point leased circuits. Providing a second, redundant circuit would then insure that a connection was possible under almost all circumstances. This had been the practice in the RCN in the past. At the time of this design dial backup modems were being tested for use in the case of a circuit failure. Their use would eliminate the need for extra backup circuits.

A more economical means of achieving redundancy was possible. In the X.25 network, lines may be run from location to location to create a shared loop. Traffic may then be carried in either direction over this loop, so in the event of a single link failure there is a redundant path. This approach is less costly (fewer circuit miles) than duplicate circuits and can be engineered to achieve a measure of traffic balancing at the same time. The use of duplicate circuits is thereby avoided, although the use of such backup routes may result in slower throughput.

Two interconnected loops were used to connect all of the 413 locations and balance their loads. Redundancy can then be maintained to all locations and even within the T1 link to Boston. Since the University of Massachusetts at Amherst was linked to Boston by its own T1 and the State T1 was not yet available for outside use, HECN was configured using this inter-LATA linkage. The precise bandwidths and interconnections were calculated using a simple network model and the previously discussed traffic estimates.

In similar fashion it is possible to create looped circuits in the 617 LATA. The campus geography naturally divides locations into northern, central, and southern sub-networks after the metropolitan Boston locations have been isolated. In each of these cases consolidation, redundancy, and flexible access between sites have been achieved. Figure 1 shows the consolidated network and the metropolitan Boston circuits.

ACQUISITION

PRODUCT SELECTION

Historically, the RCN used an informal bidding system to acquire software and hardware. Preliminary negotiations, refinements of the statement of requirements and cost estimates were, in fact, pursued in this fashion with a group of 17 vendors selected for their experience with packet switching, or their breadth of communications offerings and their projected ability to support an statewide network in Massachusetts.

The source of the funds for HECN caused the actual procurement for the X.25 PADs and switches to go through the Commonwealth's Bureau of Systems Policy and Planning (BSPP) which is charged with administering all competitive data processing acquisitions. The existence of a large installed base allowed the RCN to "sole source" the modems. The competitive X.25 pad and switch procurement took a period of five months to complete including the final negotiations. The modem negotiations which were conducted by BSPP took almost as long.

IMPLEMENTATION

Prior to the product selection activities, environmental requirements were established for the campus-sited equipment and circuits were placed on order with AT&T and New England Telephone. Once the two vendors were chosen, (one for the pads and switches and one for the modems) implementation awaited only the conclusions of the contract terms negotiation. Each of the vendors was poised, ready to begin installation and training. During May and June of this period, it was necessary to devise several temporary measures to get the campuses "on-line" to MMARS for training and familiarization. A makeshift use of existing leased lines was employed.

The contract specified that installation must be completed within 45 days of the contract signing, and it was. An ambitious delivery and installation schedule was devised and each geographic "loop" was installed separately. Each "loop" was installed in just over a week. More problems were encountered with bringing up the new circuits than with implementing the network hardware. During implementation, the RCN staff began producing a network newsletter, "The HECN Update," which is circulated to all involved parties on the campuses and at state agencies.

ACCEPTANCE

One of the strong points of the final contract was the provisions for acceptance testing. During this period the network was tested to determine that every switch, pad, and option was functional. July and August are slow periods for academic and administrative utilization which simplified this task somewhat, but left unanswered the questions of performance under load. Terminal emulations and protocol conversion problems complicated the acceptance because it was not initially clear where the problems originated. RENEX protocol converters are used to convert the asynchronous traffic to SDLC for these connections to the OMIS (IBM) mainframes and MMARS.

OPERATIONAL PERSPECTIVES

The resultant network consists of 46 circuits. It contains 48 X.25 switches, 65 PADs, and provides approximately 725 campus ports to the network and 128 ports to OMIS.

OPERATIONS/PERFORMANCE

Technically, the normal operation of this network is no more complicated than traditional point-to-point or multi-drop networks. However, the routing parameters and options which provide the flexibility of the X.25 approach also introduce a measure of complexity to tuning the network's performance. Today, the average response time compares favorably with that of the prior network.

MANAGEMENT

Network management at the RCN allows the communications staff to monitor the performance and traffic of each PAD and switch in the network on a connection by connection basis either manually or automatically. The Codex network management system which the RCN already had in place allows the staff to monitor concurrently the line conditions and error rates on each circuit. The two "pictures" of the network are complementary and provide a good basis for prompt identification of most trouble situations - in most cases before users complain. The PADs and switches located on each campus can be remotely accessed from the RCN Control Center (over HECN or via dialup) for diagnosis and new parameter downloading where necessary.

BENEFITS

HECN not only provides access to the Commonwealth's administrative systems resources at DMIS, but also has created the necessary environment for unparalleled ease of data communications between campus computer systems and the potential for a new level of collective effort and benefit within public higher education in Massachusetts. Electronic mail and BITNET access have been extended to all campuses using the RCN computers and HECN access. Connectivity to the PLATO resource located on the University of Massachusetts at Amherst campus is also now available.

Yet surprisingly, there is frustration in the very successes of HECN in providing a mechanism for access to a much broader spectrum of educational resources. It was disappointing to find that the X.25 interfaces provided by most manufacturers do not yet provide the full promised X.25 functionality. Hence the direct computer to network interfaces have been limited to date. On the other hand, the anticipated difficulties of connecting local area networks to HECN have not materialized. The ISN (AT&T) at Fitchburg State College, DEC-net at Holyoke Community College and Southeastern Massachusetts University, and the data interface of the Rolm PBX at Northern Essex Community College were readily connected and are providing flexible interfaces.

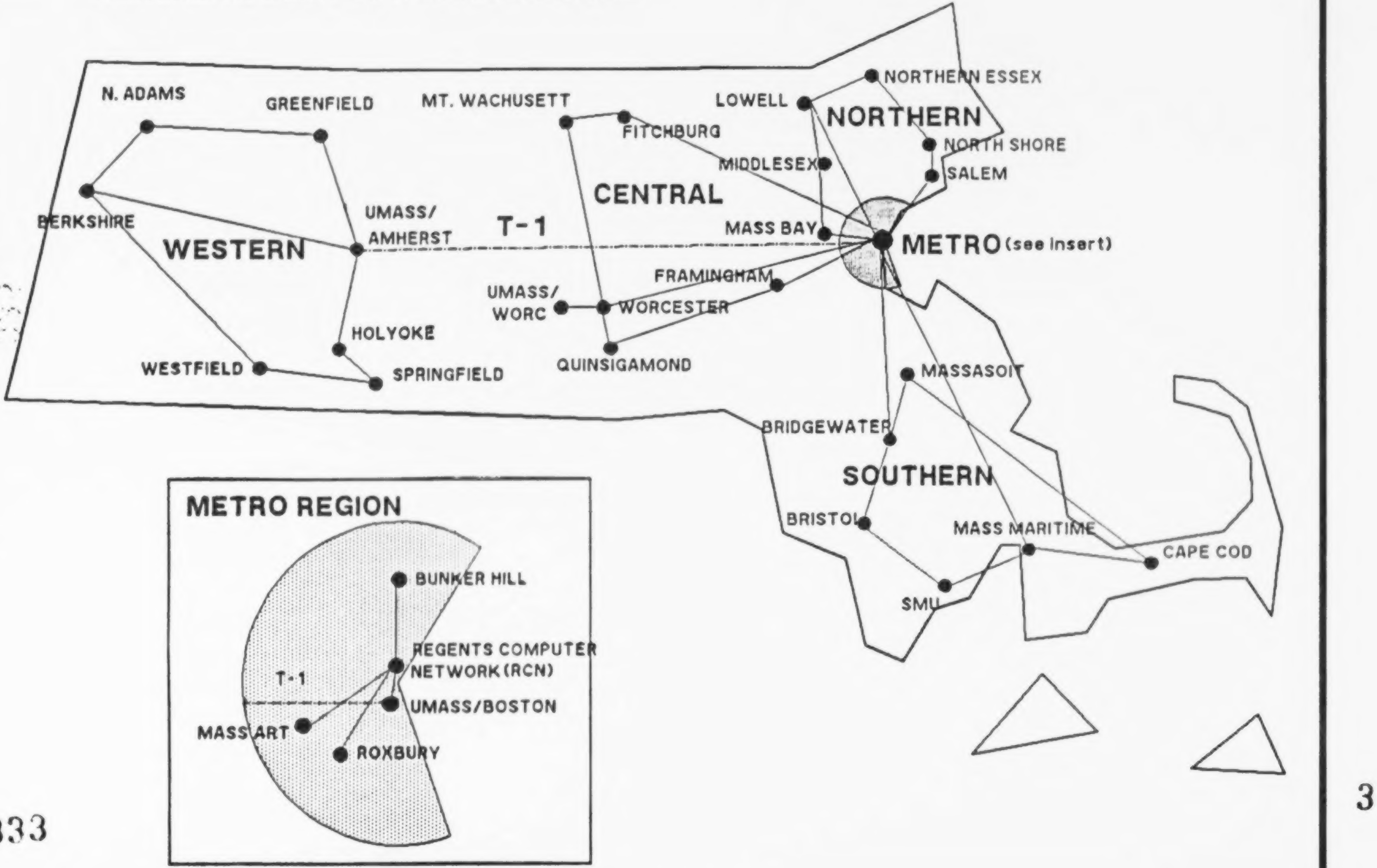
HECN is still a somewhat "techy" environment, requiring parameters and switches to be set from time to time. The network's electronic mail is bringing the academic and administrative community together as never before, but there are those key offices where it is still a problem to introduce the use of a terminal. We have been forced to realize that the network is more than the technology of HECN. It reaches beyond the PAD to embrace not only the terminal, but the user and potential user as well. Our user support services have had to move far beyond the simple explanations of how HECN works to understanding and assisting with the communications environment on the campuses. HECN is no longer a simple utility; it now embodies many attributes of a mission. Certainly higher education in Massachusetts will never be the same again.

FUTURE POTENTIALS

In the future, connection to more public networks is anticipated. In addition, there is the prospect of utilizing HECN to connect users to a super computer site as well as to serve other state agencies who need access to the same geographic areas served by HECN and to link all of the campus and state library systems. The throughput of the PADs and switches is sufficient with upgraded circuit speeds to accommodate these demands and those of potential applications which generate high traffic such as CAD-CAM or image transmission or a pronounced migration of state agencies onto HECN from their current dedicated leased line multi-drop networks.

The X.25 protocol lends itself to any type of integration. It can occupy one or more channels on a broadband circuit or it can be merged into an integrated voice and data packet transmission. HECN, itself, can even become the basis for a local campus network as easily as it connects terminals now between campuses. The resource for innovative connectivity and applications is present. It is now up to the RCN and the campuses to exploit this potential.

Higher Education Communications Network
Commonwealth of Massachusetts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SOUTHERN
BRISTOL
MASS MARITIME
CAPE COD
SMU
METRO REGION
BUNKER HILL
REGENTS COMPUTER
NETWORK (RCN)
T-1
UMASS/BOSTON
MASS ART
ROXBURY

A SOFTWARE DEFINED INTEGRATED T1 DIGITAL NETWORK FOR VOICE, DATA AND VIDEO

JAMES R. HILL

DIRECTOR OF INFORMATION TECHNOLOGY

DALLAS COUNTY COMMUNITY COLLEGE DISTRICT

DALLAS, TEXAS 75150

The Dallas County Community College District developed and implemented a strategic plan for communications that utilizes a county-wide integrated network to carry voice, data and video information to nine District locations. Designed by our consulting engineers, Diversified Communications Engineering, Inc., the network utilizes microwave, fiber optics, digital cross connect and T1 technology to provide the first software defined educational network to merge all three technologies into one common digital pipeline. The plan included planning and installation of new digital switches for voice, a packet switched-wide area network for data, and compressed video codecs for video teleconferencing and instruction. The presentation will cover the development of the strategic plan, the procurement process, the planning for installation, and the installation and implementation events. The network was installed and operational by May 1986 and has an anticipated 8 year life span.

THE ENVIRONMENT

The Dallas County Community College District is composed of seven campuses and two District offices providing educational support to all Dallas County residents. Campuses are located within fifteen minutes driving time from any residence. The District serves approximately 97,000 students per semester consisting of an equal distribution of credit and non-credit. Campuses vary in size from 5,000 to 25,000 students.

THE PROBLEM

In 1984, communication responsibilities for voice were managed by the District's Facilities Division and data by Computer Services. There were no video communications intra-district, but an extensive telecourse curriculum was distributed throughout the county by the local public television station.

Voice switches were on each campus and were leased from AT&T, with the lease expiring in July 1986. Data circuits were 56KB DDS circuits leased from Southwestern Bell. There were eight circuits running between each campus and the District Service Center where the centralized computing center was located. Costs for voice and data services were $1.2 million per year and had increased 40% over the preceding three years. Air time for telecourses was running $175,000 per year and increasing each contract renewal.

Costs were expected to increase for voice communications with lease expiration and increased growth projected. Data communication facilities were in need of expansion at two colleges and office automation needs would require significant new facilities. Strategic planning called for additional telecourse offerings as well as intra-District instruction and teleconferencing.

The problem was coming into focus with these events.

- Expiration of PBX lease
- Additional data communication needs
- Increased video demand
- Merging technologies
- Need to contain operating costs

THE STRATEGY

In July of 1984, Ted Hughes, Vice Chancellor of Business Affairs responded with two actions:

1) Placed responsibility for all data, voice, and video communications under Jim Hill, former Director of Computer Services and now the Director of a new division named Information Technology.

2) Formed a District-wide committee with Jim Hill as chair with the charge to examine District communication needs and develop a strategic plan for a communication network that would cover a five year time frame.

The Communication Network Planning Committee met for the first time in September 1984 with representation from all campuses and District offices covering a broad spectrum - President; Vice Presidents of Instruction, Students and Business; Faculty; Directors of Purchasing and Facilities for example

The Committee, realizing the technical complexities of such a network, attempted to become more knowledgeable through selected readings, vendor presentations, and attending a conference on communication planning. At the same time, each committee member was given the charge to meet with their respective campus administrative staff or District support area to develop a communication needs analysis for present and future.

It became obvious the complexity of the task, i.e. the use of voice, data, video and image, necessitated the use of a consultant. In March of 1985, the District requested proposals for a consultant, and selected Diversified Communication Engineering (DCE) from Austin, Texas to assist the committee. In June, the committee met with Saleem Tawil, President of DCE, and Carmen Armistead, an associate in the firm. Saleem and Carmen were both licensed electrical engineers, which proved to be critical in later procurement and implementation.

During the next 4 months, the committee, with assistance from DCE, developed strategic objectives from needs assessment developed by the individual committee members, and consolidated by discussions of the full committee. The objectives were:

- Provide control over resources for services and costs
- Develop an integrated network for
- Voice
- Data
- Video
- Image
- Accommodate the present as well as the future (8 years)
- Utilize new technologies, but with restraints (system concepts proposed must have been operational at least one year)
- Provide centralized resources for network control and support
- Adopt digital switching technology
- Must be economical with reasonable payback period
- Provide for video teleconferencing.

The consulting engineer, Mr. Tawil, with these objectives as the basis, provided a written report to the committee with his recommendations for our strategic plan. Included in the report were the design criteria for new systems; a financial and cost benefit analysis for each element of the proposed system; and options and alternatives with appropriate results/sequences. The consultant recommendations were adopted by the committee and presented to, and approved by, the Board of Trustees in November 1985.

THE STRATEGIC PLAN 1986 - 1994

The foundation of the plan was a software defined, integrated digital network providing voice, data, and video communication paths between all District locations. The location of the campuses within the county provided an ideal environment for a star design microwave network. Interfirst Plaza, at 72 floors the tallest building in Dallas, was across the street from the El Centro campus and was the logical choice for the physical hub with a direct line of site for microwave to all campuses.

Digital switches would be placed on eight sites with the District office sharing the El Centro switch. Data communications would not be switched by the voice switches, but would be accommodated by multiplexors or local area networks connected by the digital network to the main computing facility at the District Service Center.

While the physical hub was located in Interfirst Plaza, it was desired that control of the entire network be placed at the District Service Center 10 miles to the east. The key to this arrangement was to place a Digital Access Cross-Connect (DACS) switch atop Interfirst Plaza which would gather all the incoming voice and data digital traffic coming from the campuses and district offices and drop-and-insert the twenty four 64KB digital channels comprising a T1 channel to the appropriate outgoing 64KB channels. Video signals would be connected by digital codecs to 1.5MB T1 channels and routed from origin to destination. The DACS was like a "big switch in the sky" and could be programmed by remote terminal from the District Service Center to monitor and change routing patterns to best suit the District needs for any time period.

The capacity between eight locations and the hub at Interfirst was designed to handle six T1 channels, each of which could carry twenty-four 64KB Channels for voice and/or data, or one video channel. Sixteen T1 channels were designed for the route between Interfirst and the District Service Center to accommodate the heavy data traffic to the computing center; the detail recording of switch traffic; and the long distance traffic being centralized at that site. Five campuses and the District Service Center were to be connected to the hub by microwave. The downtown District administrative offices were connected to the El Centro campus under the street by fiber and copper cable. Fiber cable would then connect El Centro under the street to Interfirst. The Eastfield campus would be connected to the District Service Center with 1200 ft. of fiber cable and then routed over microwave to the hub.

The plan also called for acquiring a low-power TV license and an ITFS (Instructional Television Fixed Service) license to replace reliance on local public television and meet future video instructional needs for students and businesses in the county.

A study conducted earlier in 1985 indicated a strong demand for, and demonstrated need for, automating office support functions. Thus, the strategic plan included the procurement of necessary hardware and software to accommodate over five hundred Personal Computer workstations to utilize the integrated digital network. The workstations would be multi-functional performing stand-alone micro software; connected together for office support functions of word processing, electronic mail, calendaring and scheduling, and document storage and retrieval; and interfaced by the network to the mainframe computers for terminal emulation.

THE PROCUREMENT

Specifications for the digital switches, microwave, and digital cross connect were developed by Diversified Communication Engineering and the office support hardware/software and local data network specifications were prepared by DCCCD personnel. A two-phase sealed bid process was begun in February 1986. The first phase was designed to qualify prospective vendors and select finalists -- the pre-bid conference was attended by twenty eight vendors. Five finalists were chosen for the communication network and two finalists for the office support system from seventeen vendors submitting responses to the RFP. The finalists were asked to make half-day presentations to an evaluation committee to demonstrate their understanding of the project, their organizational experience, and their commitment at the local level to successfully implement.

Following the presentations, sealed bids were again submitted by the finalists. GTE of the Southwest was selected as the General Contractor for the communication network using NEC 2400 digital switches, Harris-Farinon microwave, and Rockwell DACS. GTE was chosen for their proven installation experience with complex systems and depth of local support organization. AT&T was chosen as the contractor for a wide area network called ISN (Information System Network). This network would connect over five hundred PC's with twisted pair and fiber cable through packet-switched nodes at each location to a central minicomputer at the District Service Center for office support. Administrative and educational data communications would continue to use multiplexors for now, but would be added to the ISN in the near future. Data General was selected as the office support vendor using an MV 20,000 minicomputer and CEO (Comprehensive Electronic Office) Software. The proposed communication network was approved by the DCCCD Board of Trustees in June 1986.

THE IMPLEMENTATION

The implementation started in June 1986 with bi-weekly planning/progress meetings conducted between the contractors, DCE Consulting Engineers,and DCCCD personnel headed by Jim Hill, Director of Information Technology.

Construction of the network began in August with the first two switches cutover in September. The remaining switches were installed October - December 1986 with the exception of El Centro, which had to be re-wired, and was cutover in February 1987. Concurrent with switch installation, microwave paths were being licensed with the FCC; under-the- street right-of-way was being acquired from the City of Dallas; lease space negotiated at the top of Interfirst Plaza for microwave radios, antennas and DACS; and fiber optic cable being laid. The office support hardware and software was installed in October 1986 and training classes started. The ISN network was installed and operational at each location by March 1987. In April 1987 the microwave equipment was cutover (had been delayed three months from plan for equipment delivery) and the entire network became operational.

In addition to the uniqueness of the software defined digital network using DACS switching, there are a few other significant aspects

- Four digit dialing throughout the Districts nine locations made possible by CCIS (Common Channel Interface System) hardware and software within the NEC 2400 switches
- The use of 56KB data modules used by the NEC switches to route data from the multiplexors and ISN nodes through the switch to interface with the microwave.
- Centralized control of the NEC switches, DACS, and ISN nodes from micros located at the District Service Center--in effect achieving centralized network control for troubleshooting, traffic analysis, and modifications to meet changing conditions.

SUMMARY

The network has been performing extremely well for the past six months and appears to be "rock solid". There are over 2000 telephones of which 550 are new digital instruments with many advanced features; 620 microcomputers serving as multi-function office support workstations; 650 administrative and educational terminals; and digitally compressed video instruction between the District Service Center and Cedar Valley campus all using the integrated services digital network between the nine District locations.

The new ISN wide area network currently supports the *microcomputers on the office support network,* but all data processing terminals will be added to the network in the next six months. ITFS (Instructional Television Fixed Service) licenses have been acquired and a three-channel system will be installed by May 1988. This will permit video instruction between all campuses, as well as to local business and industry under the direction of the District's Business and Industry Professional Institute. Teleconferences as well as any other video production can be downlinked from satelite and piped over the ITFS Channels to any location.

The District has not been able to obtain a low or high power television license which was planned to replace reliance on local station transmission. The FCC is not allowing any new applications at present, so the only alternative is purchasing the license rights previously granted to another entity. The District is vigorously pursuing this approach but has not been successful to date.

The economic benefit anticipated by the strategic plan looks firm, in that over two million dollars will be saved over the eight year projected life. This savings was calculated considering present use, when in fact projected growth can be handled more economically with the new system, thus realizing even greater savings.

The two and one-half years to plan, procure and implement a state-of-art communication network has been completed with hard work and proven results that puts the District in firm control of its resources. In retrospect, the key ingredients were

- A well represented District planning committee that did a good job in assessing need and developing objectives.
- a competent consultant (Diversified Communication Engineering, Inc.), i.e. an electrical engineer that designed, specified, and coordinated a very complex, but well engineered system.
- a general contractor (GTE of the Southwest) that had the expertise, track record, and local commitment to install and implement on schedule a unique, yet solid, private communication network.

The Dallas County Community College District is proud of the result and convinced that its strategic plan has become reality. The District can contain future costs attributable to inflation and growth; have greatly expanded capabilities and capacity, and benefit from significantly reduced expenses.

CAMPUS CONNECTIVITY
WITH THE DATA/VOICE PBX

David P. Redlawsk
Director of Computing
Moravian College
Bethlehem, Pennsylvania

Like most smaller colleges, Moravian College has struggled with the issue of interconnecting computing resources on campus. Most of the typical approaches to connectivity, including high speed data links, carry with them large installation and maintenance expenses. While there are areas in which these high speed links are essential, the basic goal of campus connectivity can be reached through a lower cost alternative - the data/voice private branch exchange (PBX). Nearly everyone has a telephone, and with the PBX anyone with a telephone has the necessary cabling for a data connection.

CAMPUS CONNECTIVITY WITH THE DATA/VOICE PBX

Introduction

Over the past few years it has become a given that college campuses will somehow interconnect all computing resources that exist within their boundaries. While we can all agree that the goal of allowing users in any location to communicate with any available system is a good one, numerous ways exist to implement the goal, many of which are incompatible with each other. Most of us are struggling with issues such as cabling standards, software protocols, and costs in providing complete connectivity.

At its simplest level, connectivity means access. From the user perspective the important thing is not the technical specifications underlying the access, it is simply having it. For most users access is simply being able to sign on to the library computer, or the main academic system, or their electronic mailbox, and so on. In some cases, the transmission of files and documents is also required. In a relatively few cases (at least at a liberal arts college!), more specialized requirements exist, such as advanced function workstation access and the transmission of megapel bit mapped graphics. Generally these more advanced requirements do not pervade the entire user community. Instead most users just want to get from point "A" to point "B" with a minimum of effort.

One solution to the general access requirement is the use of the data/voice private branch exchange (PBX) to switch data communications throughout the campus.

Telephones are everywhere. All campuses, no matter how small, have telephone service. All of these phones use simple, inexpensive twisted pair wiring. Many small colleges have found it economical to install their own phone system, using a PBX instead of using the local telephone system for internal campus service. The decision to use a PBX can open up not only new voice communications opportunities but also new approaches to data connectivity throughout the campus.

Computers, of course, are becoming as ubiquitous as the telephone. At some not so distant date, it will be the norm for faculty to have their own device - terminal or PC - on their desk. Many will also have them at home. Students and administrators, too, will have machines. Many campuses also find they have disparate computing facilities, including an academic computing system, an administrative computing system, a library system, departmental systems, and local area networks. The Voice/Data PBX can provide the link to allow a user in one location, using one device, to access any of these campus computing resources.

The Moravian College Environment

Moravian College is a small liberal arts college located in Bethlehem, Pennsylvania. Founded in 1742, by the Moravians who settled Bethlehem, the College is the sixth oldest in the United States. Moravian enrolls 1200 full-time students, 600 Continuing Studies students, and 60 at the Moravian Seminary. The College is split between two campuses, about a mile apart. The South Campus is in the heart of historic Bethlehem, and is home to the College's Center for Music and Art. About 50 students live on the South Campus, and about 16 faculty have offices there. The President's house is also on the South Campus.

Moravian offers programs in 39 areas, including degrees in Computer Science and Information Systems. The College has a strong liberal arts tradition. In the past few years the use of computers has grown to encompass many nontraditional areas. The Art department has a lab of Commodore Amigas, used in a specially developed graphic arts program. All students in the department of Education get extensive experience on Apple II computers. And in History and in Classics, professors are using IBM PCs to enhance their courses. The College maintains a lab of Zenith PCs and IBM PS/2s on an IBM Token Ring network. There is also an Ethernet network throughout the Hall of Science building, tying in all Computer Science faculty and machines.

All of the activity related to the data/voice PBX has occurred on the main campus only. The South Campus has a separate, voice only, telephone switch. Responsibility for the telephone system is split between the Director of Business Affairs, who has voice responsibility, and the Director of Computing, who is responsible for all data communications. Under Moravian's unified computing structure, the Director of Computing has overall responsibility for all computing. Reporting to him are a Manager of Administrative Computing and a Director of Academic Computing. The Director of Computing reports to the Vice-president for Administration.

The PBX as Central to Campus Connectivity

Over the past three years, the Academic Computing Committee has struggled to define approaches for connecting all academic computing resources on the campus. In its first incarnation the plan called for some sort of campus high-speed backbone network, linking all main administrative, faculty office, and classroom buildings. In this approach, no specific plan was created for student access from the dormitories. While the Committee, and later the Faculty as a whole, endorsed this plan, the realities of life at a small college have precluded its implementation. Most specifically, the costs of such a high-speed backbone are prohibitive at this time. While strongly supported by the Computer Science department, work on this plan has not been begun, other than in some small way by Computer Science itself.

While discussions about the establishment of a campus academic network were underway, two other events occurred. First, the administrative computing area installed a new computer greatly expanding the number of users who would be accessing administrative systems. In order to facilitate this, a new telephone system was also installed using a Rolm CBX II that supported both voice and data access. The idea was to lay the cable only once and to make it do double duty. Second, the microcomputer laboratory facilities were expanded. Because of continuing software distribution problems, the lab was networked in order to provide access to software via a file server. The network chosen was the IBM Token Ring. Twenty-seven computers, including sixteen Zenith PCs and eleven IBM PS/2 Model 30s were tied into an IBM PS/2 Model 80 as the server.

Suddenly, Moravian found itself with three campus computing networks, handling three distinct environments. It became clear that searching for "the One" campus connectivity strategy may have been a mistake. Instead, specific requirements were being fulfilled with very specific solutions. In Computer Science, where the need was for connectivity of three Unix based CPUs along with several advanced function workstations and faculty PCs, an Ethernet was installed, running SUN NFS over TCP/IP. This provides ten megabit access, allowing the transfer of very large files and images. In the micro lab, where faculty often hold classes and tell their students to all "push the enter key now" at the same time, the token ring has proven superior to Ethernet, even though Ethernet has higher nominal data speeds. The avoidance of collisions under the token ring improves actual throughput in the lab/classroom environment. Finally, in administrative offices, where the number of users has grown from eight to eighty in one year, access through the phone switch has provided flexibility and allowed the management of port contention to minimize systems connectivity costs.

The solution to the Moravian connectivity issue has become straightforward - allow specialized function networks where necessary, but tie it all together using the data/voice PBX. This will cut costs significantly by tailoring to the user exactly the type of access he or she requires. Since most users do not require high speed access at this time, the switch is the perfect solution for them.

Probably 90 percent of Moravian's users can have connectivity needs satisfied by the PBX.

Advantages of the Data/Voice PBX

While not sufficient to meet all connectivity needs of the College, the PBX has the ability to handle a large number of them. Access through the PBX is asynchronous at speeds up to 19.2K BPS. Any system capable of "talking" asynchronously can be directly attached to the switch, through any data-equipped telephone. Non-asynchronous devices can be attached via protocol conversion internal to the switch. Just like when using a telephone for voice, using the switch for data provides the user a direct point-to-point exclusive line for the duration of the session. When finished, the line becomes available for another user. Because of this switched nature, systems with different configurations and requirements can be accessed with the same device from the user's desk. Thus, the user can first access a DEC host, then turn around and log onto an IBM system, with the same inexpensive ASCII terminal or PC. And while he is accessing systems through the PBX, his telephone is still available for voice calls.

The use of the PBX affords some unique advantages over other connectivity approaches, in addition to the switching between systems. Some of the most significant include:

- Upon installation of a telephone system, the cable plant is already in place for data. The incremental cabling cost for data over voice is nil. Anywhere a telephone is placed a terminal or PC can be placed and connected. The only additional cost is the port, about $200, versus $500+ for other methods.

- Expansion of the terminal/PC network is easy. It is generally simply a matter of plugging the terminal or PC RS-232 interface into the appropriate outlet, if this was preplanned. Even if it was not, no additional wiring is needed, just the addition of the port. When an office moves, the cost of moving their data is just the cost of moving their phone access.

- Using the integrated data/voice PBX can provide a single vendor data/voice communications solution. This can greatly simplify problem resolution when the inevitable bugs creep up. As the lines between data and voice communications become less distinct in the future, this benefit can be significant.

- The voice and data travel over one single twisted pair of wire. Since most phone installations use four twisted pairs, there are three left over for future use at every phone jack. Given the directions of technology, these may become useful for other types of networking, including departmental Ethernets or token rings, or even slow scan video.

- Overall, using a PBX for data and voice is typically a lower cost solution than separating the two functions on different networks. Not only is duplicate cabling eliminated, but the data costs can ride on the voice costs. Typical per node costs are as little as $200, with no wiring cost.

Data Switching at Moravian

The Moravian College Computer Center provides computing support for both Academic and Administrative users. Administrative systems supported include two IBM System/36s and a DEC 11/45 which is being phased out as the former administrative machine. Academic machines include a DEC 11/70 for Computer Science and Academic Computing, and a Masscomp and a Sun 3/180 for Computer Science. The Academic systems are all running UNIX, and are connected to the Ethernet. The two System/36s are connected to each other via a 56K BPS Digital Services Adapter. The Computer Center also supports the main MS-DOS lab, networked on the IBM Token Ring, and nine Zenith PCs on the Ethernet.

All of the main Administrative and Academic systems are also connected to the data/voice PBX, via twisted pair wiring for the DECs and twinaxial wiring for the System/36s. Since the PBX is an ASCII device, no special requirements exist to attach the DEC systems. The System/36 uses a Rolmbridge 5250 Link Protocol Converter in the PBX to handle all ASCII to EBCDIC conversion. About 100 administrative and faculty users have terminals or PCs in their offices and are connected to the PBX through their RS-232 ports at 9600 BPS. In addition, many users in the Hall of Science are connected to the Ethernet.

Attached to the PBX are two groups of incoming and outgoing modems running at 2400 BPS. These are available to any user who needs access to resources off-campus from his or her office, or needs access to campus resources from elsewhere. These modems allow the user to access any Moravian system while off-campus that he or she may access on campus.

The user interface to the PBX is very simple. In the case of terminal users, switching on the terminal sends an off-hook signal to the PBX which then responds with a prompt asking the user which available system is to be called. The PBX then finds the next available port on that system and links the user to it. As far as the system is concerned, the user has a point-to-point, permanent local connection. For PC users the process is even simpler because the PC can run communications software that responds to all prompts automatically. Initially, the communications package Procomm is being used with PCs. For access to the System/36s specifically, a Rolm designed package will be installed on each PC to provide System/36 emulation.

The PBX provides a level of security that can be used to limit system access. Each data telephone location can be assigned an access level that must correspond with the level of the system being called. In addition, each system attached to the PBX can be assigned a password, which must be used when trying to call it.

Users who wish to call resources off-campus simply respond to the initial PBX prompt with the outside number they wish to call. The PBX finds an appropriate modem and places the call. In this way a few modems can be shared among a large number of users.

In all cases, if a resource is not available to be called - for example, all ports are in use - the user has the choice of being queued for the next port or hanging up and trying later.

A major concern at Moravian is to develop a single user interface to all campus networks, so that a user working from a PC in the office sees the same screens for sign-on that someone in the token-ring networked micro lab sees. The goal is that a user should be able to sit at any terminal or PC on campus and be immediately familiar with what he sees on the menu screens. So far, this has been achieved in the token ring lab and on the PCs attached to the Ethernet through the development of a network menuing system. While the underlying system commands may be different on different networks, the user never sees this and doesn't need to know any special commands.

Future Directions for Moravian

There are still a number of questions to be resolved in developing total connectivity throughout the campus. The most significant problem is in determining actual requirements and fitting the appropriate technology. Users do not always know their requirements, and will often either under or over estimate the type of access they need. A faculty Academic Computing Committee is charged with developing policy and directions for future connectivity growth. This committee has representation from many department that might be considered outside of the mainstream of computing. However, at Moravian, everyone is considered a potential user.

The Rolm PBX has become the hub of what will be a campus wide network, encompassing offices, dormitories, and the South Campus. The Ethernet will continue to be important, tying in those offices requiring high speed access. The micro labs will themselves be networked and bridged over to the switch or the Ethernet. Some of the directions under consideration are listed below.

Dorms. Moravian dorms do not yet have phones in every room. When these are added, the data will be added at the same time, using the Rolm switch and digital Rolmphone 120s with RS-232 ports. This would provide any student with the ability to tie in his own PC or terminal. As an added bonus, the Rolmphones will not work on the public phone network, making them useless to students outside of their dorm.

South Campus. By using a T1 link, data and voice can be multiplexed to the South Campus, providing an integrated phone system and allowing the Art Department lab and faculty/student devices access to the network. This will also allow the President enhanced access from at home, instead of his current 2400 BPS modem access.

New PBX. New Rolm technology has made the PBX 70% smaller and significantly faster in handling data communications. Ultimately, all phones will be replaced with the Rolmphones using a single twisted pair wire for data and voice, freeing up two thirds of the wiring in classroom and office buildings. Ethernet should be able to run on this wiring wherever necessary eliminating new wiring costs.

Library. Moravian is in the process of automating the library. The catalog and circulation system chosen will also be connected to the PBX, so that any user in any office can access library holdings.

Ethernet and Token Ring Network. All micro labs are or will be networked within themselves to provide local printer and file serving. These networks may be Ethernet or token ring or some other type, as long as the network bridges into the switch or the Ethernet. At present the actual bridging is done using asynchronous communications serving on the token ring and terminal serving on the Ethernet. Higher speed links are being investigated.

Conclusion

The process of interconnecting all computing resources is a difficult one, for both technological and political reasons. Costs can be very high, and there is some question as to cost/benefit justification. Certainly, in a small college like Moravian, the costs of wiring the campus with fiber optic cable, providing the finest in high speed data transmission, are prohibitive. The question we must focus on is what are the actual requirements, rather than what would be nice and sexy to have.

High speed networks like Ethernet and the token ring have their place on a campus like Moravian. However, it has become clear over the past few years that not everyone needs such a level of connectivity. The process of trying to fit the technology to the user requirements has led Moravian to discard the idea of one campus network in favor of a hybrid approach tied together by the PBX.

Ultimately, of course, the goal is simply to provide access - to give every user the ability to get on to any machine for which he or she has the authority to access. We must take into account a large variety of equipment and protocols, as well as specialized needs in many places. Rather than try to dictate to users a small list of supported machines and refuse to allow any others, Moravian is trying to be open. The hub of that openness is the integrated data/voice PBX. Use of the switch will give access at a reasonable cost throughout Moravian College.

A SIMPLE STRATEGIC PLAN FOR PROVIDING DISTRIBUTED COMPUTING RESOURCES TOGETHER WITH A TACTICAL PLAN FOR IMPLEMENTATION

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Wisconsin

ABSTRACT

Both strategic and tactical plans for providing computing resources in a distributed environment can become too complex. The complexity may result in "lock-step" implementation strategies that do not allow the institution to adjust to changing technology. A simple strategic plan is presented that forms the basis for guiding all implementations. An equally simple tactical plan is used to develop and implement the strategic plan. The results of this planning process are exhibited in OSCEO, (One Stop Computing for Everyone), the University of Wisconsin-Stevens Point computing environment.

BACKGROUND

1. Description of University of Wisconsin-Stevens Point

The University of Wisconsin-Stevens Point (UWSP) is one of eleven four-year, non-doctoral campuses in the University of Wisconsin System. UWSP has a liberal arts orientation, and offers masters degrees in selected disciplines. There are approximately 9000 students of which about 1/3 live in University maintained residence halls.

2. Status of computing before OSCEO

Prior to 1984 and the development of the strategic plan and the implementation of OSCEO, UWSP had a single combined academic and administrative mainframe computing environment and a small and varied set of micro-computers. The mainframe, a Burroughs B6930, provided services through a point-to-point coaxial terminal system. There were about 100 administrative and 30 academic terminals. There was no general data-communications network. The micro-computers on the academic side consisted mostly of a set of stand-alone Apple II+'s and a small 3Com network of IBM PC and Zenith 151 micro-computers. There were a few micro-computers in administrative offices being used for word processing.

THE STRATEGIC PLAN

1. Graphical display of the plan

The Plan was developed graphically as opposed to a prose description (see Figure 1).

2. Discussion of the Plan's components

The Plan consists of five major "environments", the student operating environment, the faculty operating environment, the department operating environment, the college/dean operating environment, and the academic administrative operating environment. Each environment has its unique requirements for service and for data. The service requirements are represented by the arrows, and are meant to be suggestive rather than exhaustive. The data is represented by the open rectangles. There is a strong overtone of data sharing and general access throughout. The thread that runs through the entire graphic is the need for an adequate communications system to link operating environments to data and to other operating environments.

3. Sequencing/ordering of the Plan's major functions

A broad and flexible sequencing strategy was accepted. The highest priority was given to the student operating environment. Next came the faculty, with the idea of hooking the students and faculty into one instructional environment. The third level of development was grouped into administrative services and functions and had the department, college, and academic administration sequenced together.

THE TACTICAL PLAN

1. The tactical plan

The tactical plan consists of specific objectives to be accomplished in various time frames ranging from one to six years. Some examples are (i) network all computers in student laboratories, (ii) provide computers to all faculty and network them, and (iii) implement a campus-wide electronic mail system.

Our philosophy in implementing the tactical plan is to be opportunistic and develop that portion of the plan that can be funded at the time. We know that our base budget is insufficient to develop the total plan. However, we are simultaneously developing several parts of the plan. We look to grant funding and special university funding along with our budget to help us meet our goals.

2. Implementation of the tactical plan

We have used a variety of methods to implement the tactical plan.

The University has had a five year Title III federal grant to improve our computing environment. This has supported the purchase of equipment, but perhaps the most important use of this funding has been in the training of faculty and staff in computing. Training has ranged from half day sessions to full year retraining leaves for some faculty. This grant prepared the campus for the new computing environment and also purchased some of its components.

Partnerships with our major vendors have been instrumental in getting the support we needed to develop this environment. This includes major equipment donations from AT&T.

We are able to increase our investment in the computing environment by helping departments purchase equipment that fits well into the environment. When we offer attractive prices and support services, departments are reluctant to purchase other equipment. In some cases, we also leverage computing budgets by cost sharing with departments. For example, departments had to pay part of the workstation cost when workstations were obtained for all faculty.

3. "Growing pains"

There are many "growing pains" as the Plan is being implemented. The two most notable will be mentioned here. They are (i) problems associated with incomplete systems, or as it might be called, the missing link syndrome, and (ii) the need for coordination.

When an opportunistic approach to implementing the Plan is used, a strategy of optimizing individual steps is taken without regard for optimizing the implementation of the Plan as a whole. The result is that parts of the Plan are implemented out of what would be the "ordinary" systems development sequence. For example in the UWSP environment, the basic data networking communications backbone rode on the back of the telephone system. The next logical step after the acquisition of the backbone would have been the acquisition of the connecting links, and then the processors and micro-computers that would be the end devices on the system. Because an extremely good deal came along on micro-computers that permitted us to provide a micro-computer to every faculty member who wanted one, we implemented that. The end result is that currently, UWSP has stand-alone systems on faculty desks which are only being used at a fraction of their potential because are not yet connected into the data communications network.

As a result of the network, many areas developed their own applications, and we developed a very distributed application environment. Our central application development staff was distributed out to user departments. This resulted in a great increase in productivity and user satisfaction. However, it soon became apparent that some coordination would be necessary. We had to have some standards if we were to be able run a cost effective system in which applications could share data when necessary. As a result the Communications and Computing Networking Coordinating Committee, representing the major users and those responsible for running the network, was established. This committee reports to the Chancellor's cabinet and, in effect, takes the place of a chief information officer. Distributed computing requires coordination and cooperation among the users and the committee creates a vehicle for this.

THE UWSP IMPLEMENTATION

1. Backbone communication

The backbone data communications system came as a result of an RFP for a voice and data switch. AT&T was the successful bidder and proposed their Premise Distribution System of fiber optic cabling between buildings, and four pair of twisted copper wires within buildings, terminating four pair at each telephone jack (Figure 2). Voice and data each has its own switch: System 85 for voice, and ISN (Information Systems Network) for data. The result is a complete backbone wiring system which could connect each telephone jack to separate voice and data systems. All that is required is to hang the devices on the ends.

2. Multiple levels of communications networks

Our current implementation of the network is to attach each PC to a Starlan local area network. These networks are bridged through the ISN so that the network appears to the user to be one large Starlan. Through network servers we are able to provide our users a friendly menu driven operating environment.

Computers which cannot be Starlan devices attach as asynchronous devices to the ISN. Users access these computers from their PC's by terminal emulation. The ISN provides the connectivity service between Starlan and these computers.

3. The role of the workstation

Our workstation is an MS(PC)-DOS computer. It must have at least one full-size expansion slot for a Starlan board and should have 640K of memory to effectively use the software available on the network.

The workstation is a crucial element in the one-stop computing environment. We do not have terminals on campus. All computing resources are available at each workstation through stand-alone operation, services provided by network servers, or terminal emulation.

4. The need for coordination

In a distributed environment, control is replaced by cooperation. As indicated above, all involved in running the network and developing applications must work together to insure that the system will function properly and best meet the needs of all users.

5. OSCEO as of today.

The idea of "one stop computing" has been implemented at the student workstation. All the computing resources of the campus that are used for student instruction can be reached from any student workstation. A user interface in the form of a simple "point and pick" menu system has been implemented to assist students in navigating through the applications available. Figures 3 exhibits the menu presentation and shows the current level of resources available to the students.

Very little work has been done on the faculty, department, college/dean, and academic administrative operating environments. Most of the work to date has been on constructing the base data collection systems, e.g., student records system, financial systems, library automation. These data collection systems, when operational, will provide the service devices for constructing the appropriate operating environment within the Plan.

SUMMARY AND CONCLUSIONS

1. You too can do it

Distributed Computing For The Rest of Us

While it is not possible for a university with a small computing budget to have distributed computing like the "big guys", it is possible to get most of the functionality at a fraction of the cost. Here are the principles we have followed:

- Use "off the shelf" parts. Build your computing system from commonly available pieces which can be bid competitively.

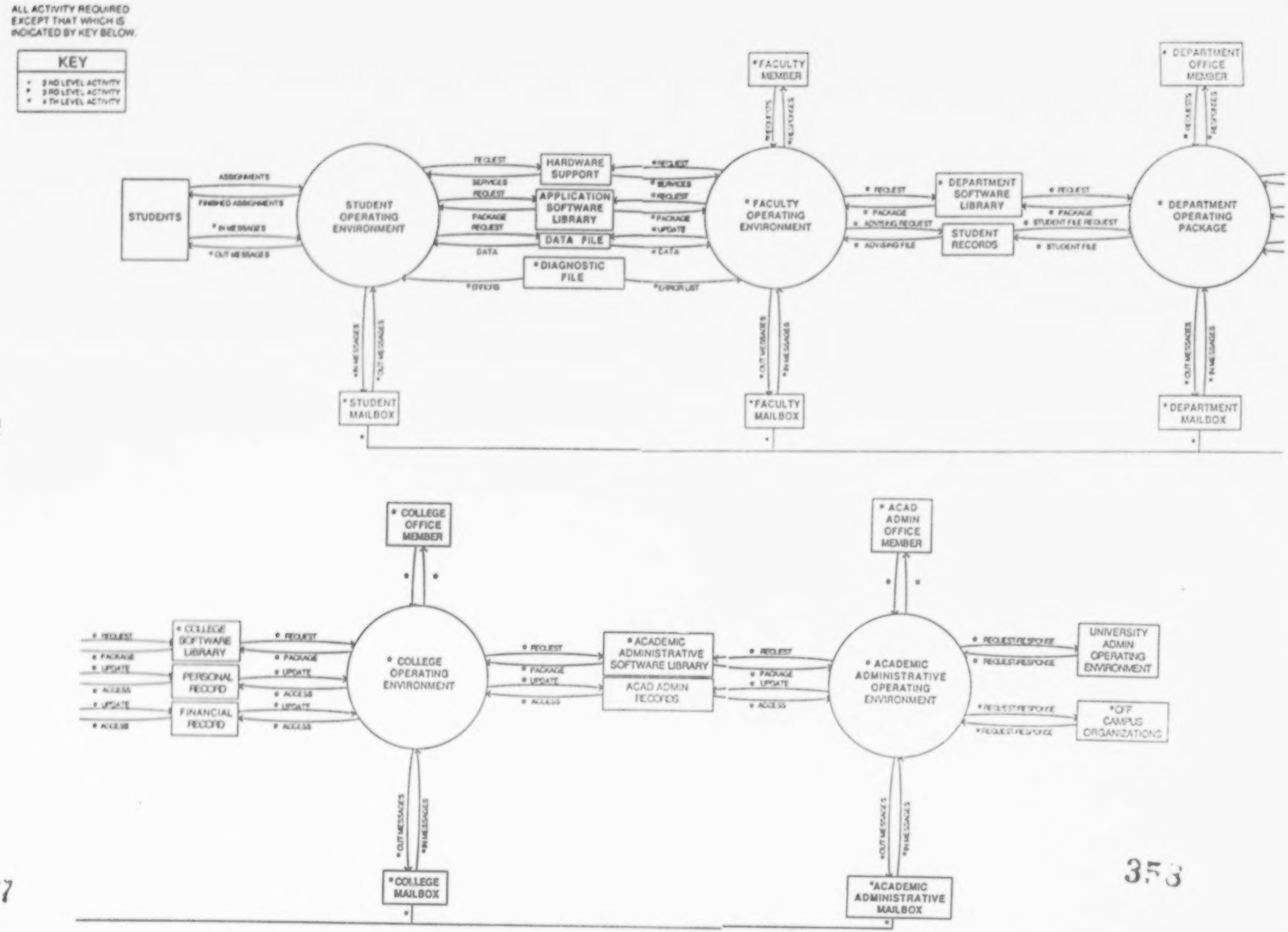
- Keep the user on the smallest computer that will effectively do the job. The economics of computing has changed. Now, the smaller the computer the lower the per station cost.

- Give up some variety so that you can support what you do have well. Users may have to give up their "pet" hardware or software, but everyone gains in the long run from a limited but well supported environment. This is best accomplished by making the environment so attractive that users are reluctant to move away from it.

- Have good strategic and tactical plans, but be opportunistic in their implementation. Do not interpret the plan and its priorities so rigidly that opportunities which arise as a result of grants, vendor relationships, or administrative support are lost. If it fits the strategic plan, do it, and pick up the pieces later.

2. OSCEO for the future

Figure 4 provides a conceptual view of OSCEO's future. Four logical networks (all running on the same physical network) serving the three main constituencies will be developed. One network will be the person-to-person communications network. Here activities such as, electronic mail, teleconferencing, and joint document preparation will take place. The other three networks will be person-to-information networks. Each of these networks will have information applications added as needed, and can be thought of as a menu pick within the operating environment, connecting the person to the data/application. Each will add one more dimension in implementing the information aspect of the Plan that was suggested in the original graphic.


ALL ACTIVITY REQUIRED EXCEPT THAT WHICH IS INDICATED BY KEY BELOW.
KEY
• 2 ND LEVEL ACTIVITY
• 3 RD LEVEL ACTIVITY
• 4 TH LEVEL ACTIVITY
STUDENTS
ASSIGNMENTS
FINISHED ASSIGNMENTS
• IN MESSAGES
• OUT MESSAGES
STUDENT OPERATING ENVIRONMENT
REQUEST
HARDWARE SUPPORT
SERVICES
REQUEST
APPLICATION SOFTWARE LIBRARY
PACKAGE
REQUEST
DATA FILE
DATA
• DIAGNOSTIC FILE
• ERRORS
• ERROR LIST
• REQUEST
• SERVICES
• REQUEST
• PACKAGE
• UPDATE
• DATA
• FACULTY MEMBER
• REQUESTS
• SERVICES
• FACULTY OPERATING ENVIRONMENT
• REQUEST
• PACKAGE
• DEPARTMENT SOFTWARE LIBRARY
• ADVISING REQUEST
• ADVISING FILE
STUDENT RECORDS
• REQUEST
• PACKAGE
• STUDENT FILE REQUEST
• STUDENT FILE
• DEPARTMENT OFFICE MEMBER
• REQUESTS
• SERVICES
• DEPARTMENT OPERATING PACKAGE
• IN MESSAGES
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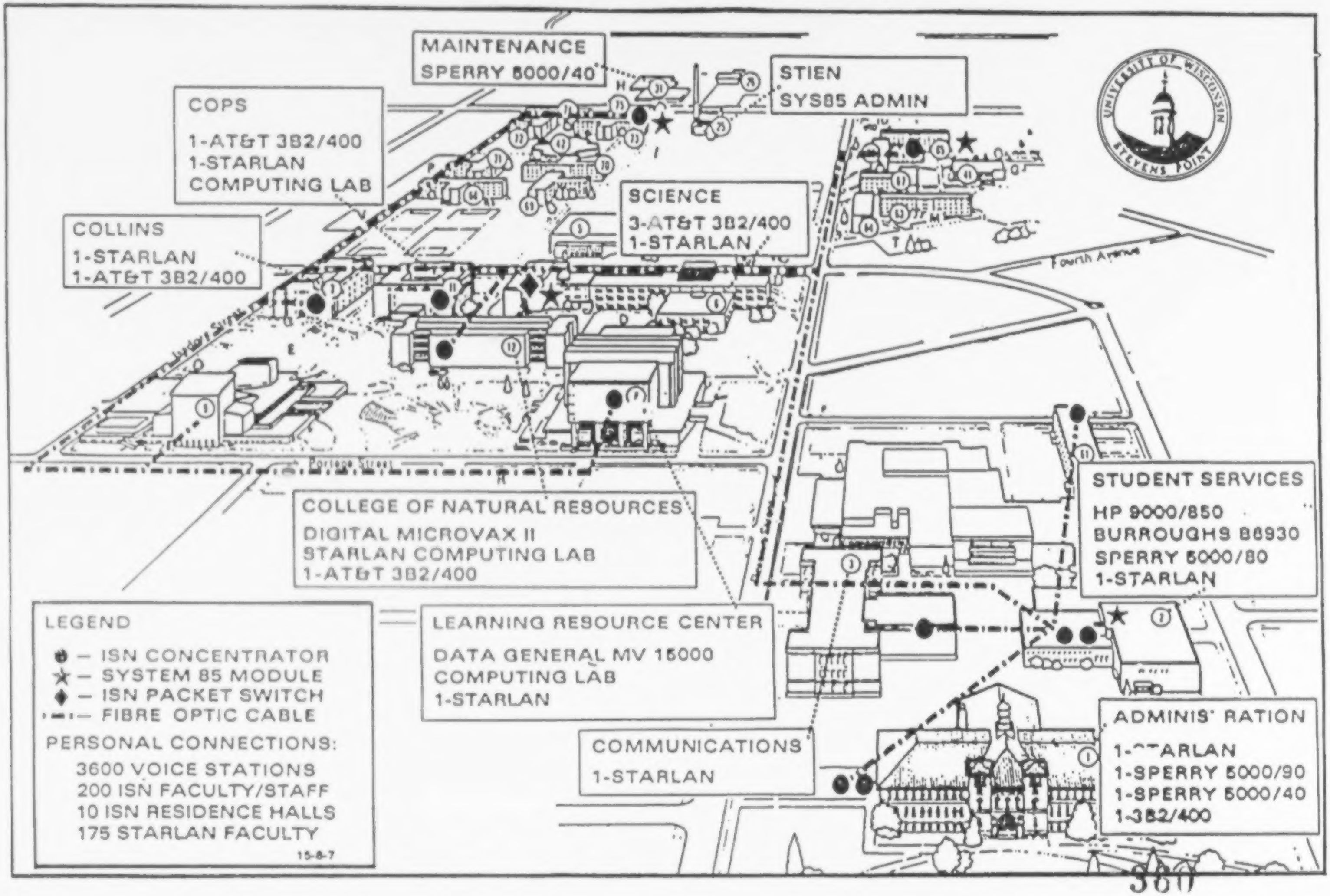
• REQUEST
• PACKAGE
• UPDATE
• ACCESS
• UPDATE
• ACCESS
• COLLEGE SOFTWARE LIBRARY
PERSONAL RECORD
FINANCIAL RECORD
• REQUEST
• PACKAGE
• UPDATE
• ACCESS
• UPDATE
• ACCESS
• COLLEGE OPERATING ENVIRONMENT
• REQUEST
• PACKAGE
• UPDATE
• ACCESS
• ACADEMIC ADMINISTRATIVE SOFTWARE LIBRARY
ACAD ADMIN RECORDS
• REQUEST
• PACKAGE
• UPDATE
• ACCESS
• ACAD ADMIN OFFICE MEMBER
• ACADEMIC ADMINISTRATIVE OPERATING ENVIRONMENT
• REQUEST/RESPONSE
• REQUEST/RESPONSE
UNIVERSITY ADMIN OPERATING ENVIRONMENT
• REQUEST/RESPONSE
• REQUEST/RESPONSE
• OFF CAMPUS ORGANIZATIONS
• OUT MESSAGES
• IN MESSAGES
• COLLEGE MAILBOX
• OUT MESSAGES
• IN MESSAGES
• ACADEMIC ADMINISTRATIVE MAILBOX

Figure 1

UWSP COMPUTER NETWORK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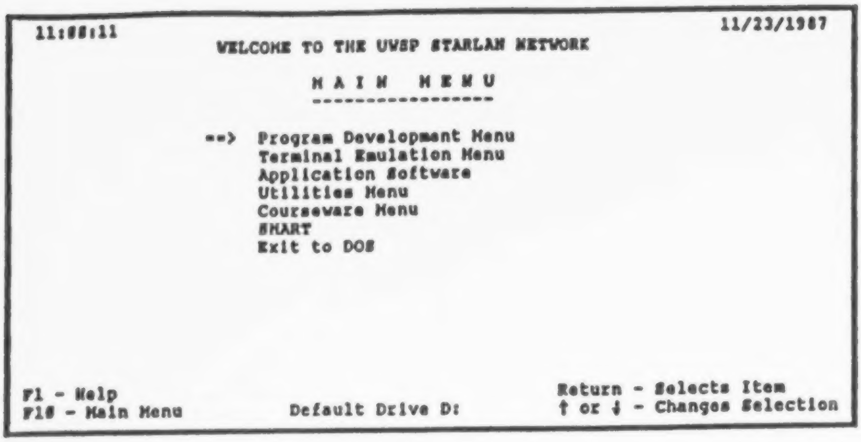
STIEN
SYS85 ADMIN
COPS
1-AT&T 3B2/400
1-STARLAN
COMPUTING LAB
SCIENCE
3-AT&T 3B2/400
1-STARLAN
COLLINS
1-STARLAN
1-AT&T 3B2/400
UNIVERSITY OF WISCONSIN STEVENS POINT
Fourth Avenue
Portage Street
COLLEGE OF NATURAL RESOURCES
DIGITAL MICROVAX II
STARLAN COMPUTING LAB
1-AT&T 3B2/400
STUDENT SERVICES
HP 9000/850
BURROUGHS B6930
SPERRY 5000/80
1-STARLAN
LEGEND
● – ISN CONCENTRATOR
★ – SYSTEM 85 MODULE
◆ – ISN PACKET SWITCH
–·– FIBRE OPTIC CABLE
PERSONAL CONNECTIONS:
3600 VOICE STATIONS
200 ISN FACULTY/STAFF
10 ISN RESIDENCE HALLS
175 STARLAN FACULTY
15-8-7
LEARNING RESOURCE CENTER
DATA GENERAL MV 15000
COMPUTING LAB
1-STARLAN
COMMUNICATIONS
1-STARLAN
ADMINISTRATION
1-STARLAN
1-SPERRY 5000/90
1-SPERRY 5000/40
1-3B2/400

Figure 2



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11:08:11                                                    11/23/1987
                 WELCOME TO THE UWSP STARLAN NETWORK

                          M A I N   M E N U
                          -----------------

                   ==>  Program Development Menu
                        Terminal Emulation Menu
                        Application Software
                        Utilities Menu
                        Courseware Menu
                        SMART
                        Exit to DOS

F1 - Help                                       Return - Selects Item
F10 - Main Menu          Default Drive D:       ↑ or ↓ - Changes Selection
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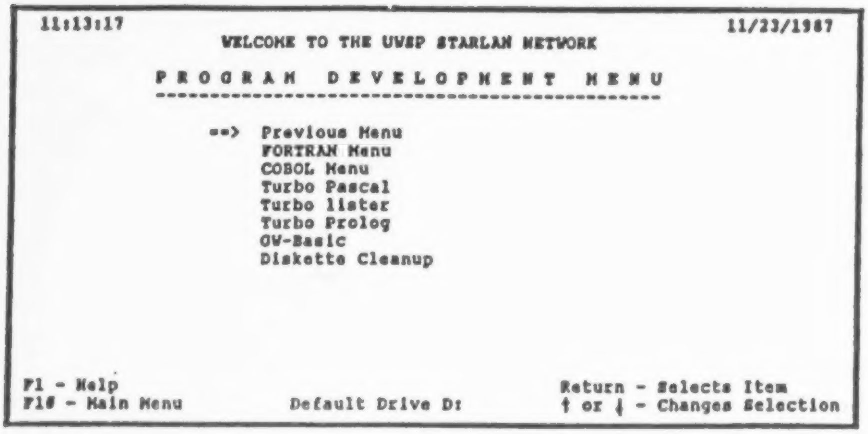

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11:13:17                                                    11/23/1987
                 WELCOME TO THE UWSP STARLAN NETWORK

           P R O G R A M   D E V E L O P M E N T   M E N U
           -----------------------------------------------

                   ==>  Previous Menu
                        FORTRAN Menu
                        COBOL Menu
                        Turbo Pascal
                        Turbo lister
                        Turbo Prolog
                        GW-Basic
                        Diskette Cleanup

F1 - Help                                       Return - Selects Item
F10 - Main Menu          Default Drive D:       ↑ or ↓ - Changes Selection
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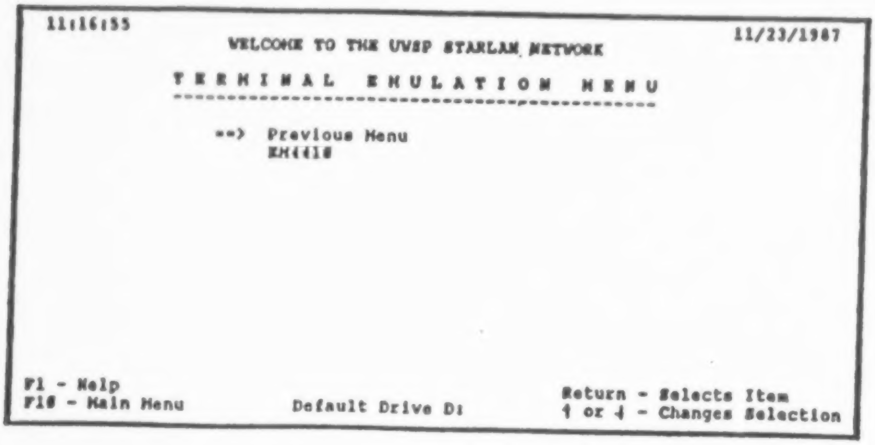

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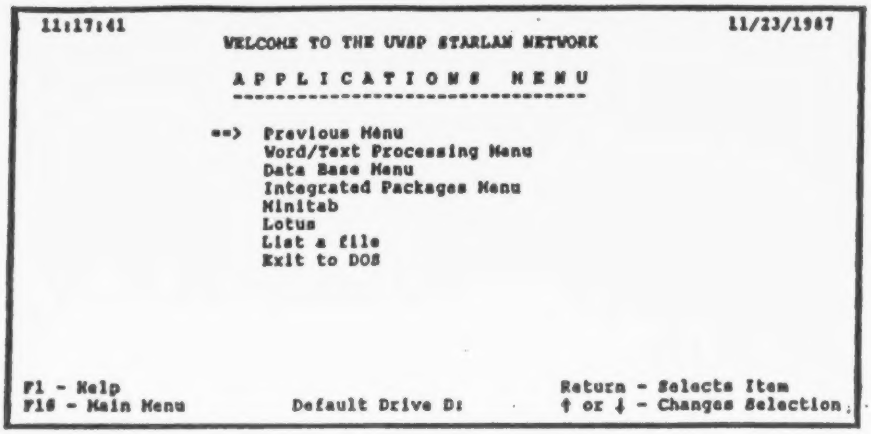
Figure 3



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                       Data Base Menu
                       Integrated Packages Menu
                       Minitab
                       Lotus
                       List a file
                       Exit to DOS





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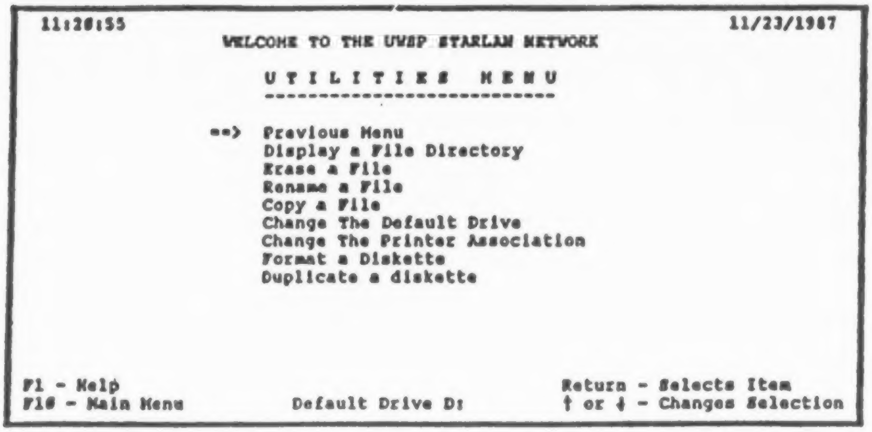

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                        U T I L I T I E S   M E N U
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                       Erase a File
                       Rename a File
                       Copy a File
                       Change The Default Drive
                       Change The Printer Association
                       Format a Diskette
                       Duplicate a diskette



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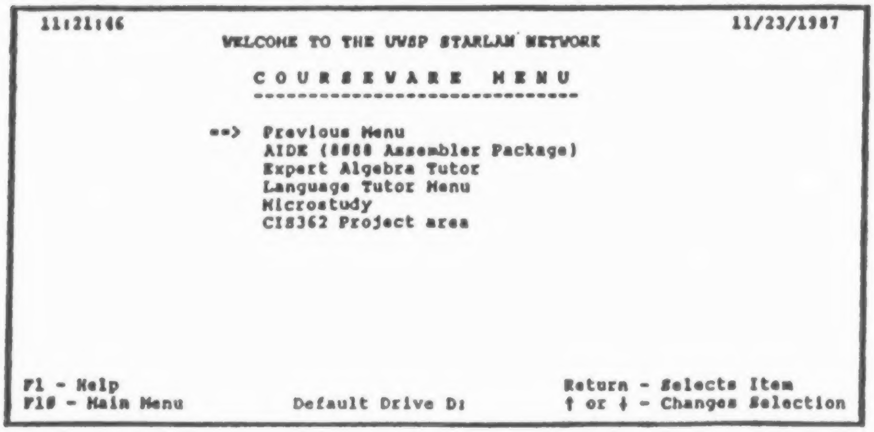

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                      C O U R S E W A R E   M E N U
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                       Expert Algebra Tutor
                       Language Tutor Menu
                       Microstudy
                       CIS362 Project area





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Figure 3 (cont'd)

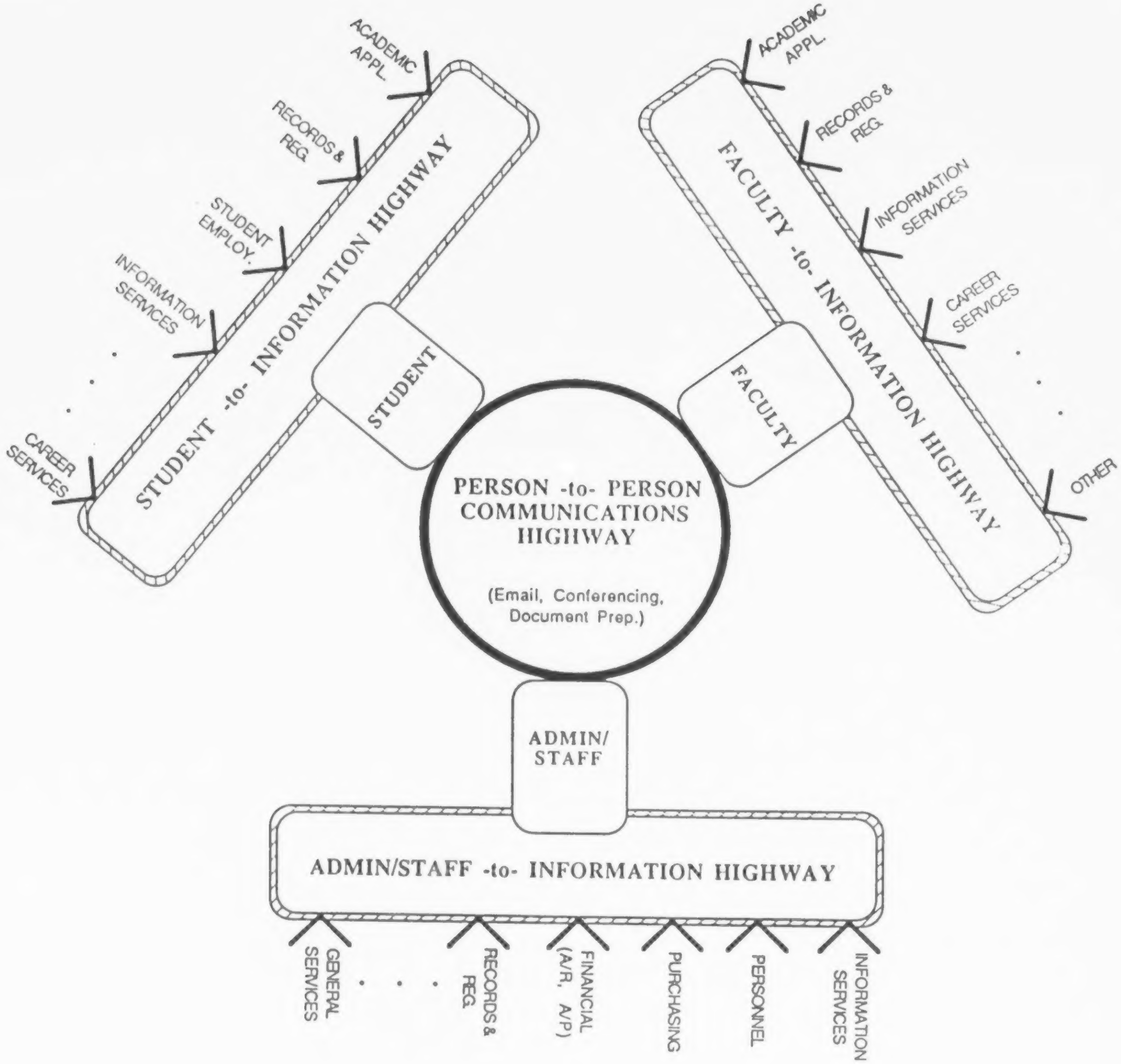
STUDENT -to- INFORMATION HIGHWAY
ACADEMIC APPL.
RECORDS & REG.
STUDENT EMPLOY.
INFORMATION SERVICES
CAREER SERVICES
STUDENT
FACULTY -to- INFORMATION HIGHWAY
ACADEMIC APPL.
RECORDS & REG.
INFORMATION SERVICES
CAREER SERVICES
OTHER
FACULTY
PERSON -to- PERSON COMMUNICATIONS HIGHWAY
(Email, Conferencing, Document Prep.)
ADMIN/ STAFF
ADMIN/STAFF -to- INFORMATION HIGHWAY
GENERAL SERVICES
RECORDS & REG.
FINANCIAL (A/R, A/P)
PURCHASING
PERSONNEL
INFORMATION SERVICES

Figure 4

Strategies for Financing the University Communications Utility

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Abstract

Universities are realizing that in order to remain competitive, supporting information systems must provide for state-of-the-art capabilities. The problem of financing this battle with obsolescence is even more perplexing as, campus-by-campus, there is the realization that the entire communications infrastructure is significantly outdated. Recabling a campus and developing modern data, video, and telephone services can require millions of dollars in capital financing - typically $1000 to $3000 for every individual served by the utility. Concomitant increases in annual operating costs can also be significant. A university's choices for covering these expenditures include the reallocation of budget allocations, the establishment of a communications cost center with revenues from the resale of services, and the development of privately sponsored projects. In addition, improved management, improved planning, and new technologies offer opportunities for cost control and for funding of needed upgrades in facilities. These issues are examined in the context of Virginia Tech's strategy and experience in the financing of its communications network development activities. Projects include the recabling of the campus, the development and interconnection of departmental local area network, the development of private long distance capabilities, the development of the Virginia Tech - Corporate Research Center Teleport, and the development of other voice, data, and video communications capabilities.

The Price of Competitiveness

We gave a presentation at CAUSE84 on some of the technological choices relevant to the establishment of a university communications utility. We concluded that talk with the following statement:

"Risks are inherent in aggressively pursuing these opportunities. But perhaps the most significant risks belong to those not yet aware of problems inherent in old communications infrastructures relative to current and future demand. Their risk will be realized in terms of lost competitiveness."

Following that talk, we were asked by several individuals, "But how are you paying for that utility?" We will answer that question by briefly reviewing the rational for our efforts, the financing strategies utilized, and the application of that strategy in several communications development projects.

Strategic Thinking

Communications infrastructure affects institutional competitiveness. The long-term effect on competitiveness is determined by how efficiently and effectively that infrastructure shrinks distances and stretches time. One of the opportunities for colleges and universities is to reduce the cost of communications. However, in the increasingly competitive setting of higher education, the more important opportunities are to increase market accessibility and to create service differentiation.

Strategic Financing

Since Virginia Tech's Communications Network Services organization is operated as a cost recovery utility, two questions dictate its "strategic thinking." First, what facilities and services should it develop in order to advance the University's competitiveness? And, second, how is it going to pay for these facilities and services? The "strategic thinking," therefore, tends to be dominated by "strategic financing" issues.

Our short-term goals have been (1) to control costs, (2) to build the competence of the communications support organization, and (3) to educate constituencies about the opportunities and risks of being leading edge players in the communications game. The long-term goals have been (1) to develop a basic network architecture which would be functionally robust and adaptive to changing technology and (2) to create a financially stable, self-supporting utility. Appropriate and timely strategic positioning - with respect to making reasonable technological choices and to getting into the right markets - determines long-term financial stability.

Because of the self-supporting standard, every project and every organizational activity must contribute to the financial integrity of the utility. That "self-supporting standard" has been the price of aggressively developing our communications infrastructure - and, therefore, the price of improved competitiveness.

Financing Alternatives

Financing alternatives vary with the purpose and temporal aspects of the expenditures being financed. These may be classified as either operating expenditures or capital expenditures.

Operating Expenditures

Operating expenditures include all of those annually recurring costs necessary to support the communications utility. Included are costs for personnel and training, costs for maintenance, spare parts, contractual support, costs for leased services including video programming, long distance communications links and satellite time, costs for replacement and enhancement of facilities, and debt service costs.

Financing sources for operating expenditures are limited. For instance, it is generally not possible for a university to borrow funds to cover operating costs. The exception is the aggressive management of cash flow in order to cover temporary shortfalls in operating monies.

Operating expenditures are normally covered within a university one or more of three ways:

- "off-the-top" budgeting of the communications utility;
- connection and usage fees to the users of the utility;
- resale of "surplus" services to non-university users.

At most universities, tradition has led to "off-the-top" support for basic data communications services and usage charges to the user of telephone services. At Virginia Tech, however, users of data services are billed at an average rate of $25 per connection per month. Prior to the implementation of our own facility, telephone services have been charged directly to the users at an average price of $33 per station per month. Long distance services are billed to the user at an average rate of approximately 32 cents per minute.

Resale potential, including sales of voice, data, and video services, may be considerable. Potential buyers of these services include on-campus students. However, this market may also include off-campus students, non-university faculty and staff usage, private businesses, especially those in a university research park, and other public sector users, including other colleges and universities.

Capital Expenditures

Capital expenditures are so-called "one-time" costs. These are the monies that cover the "up-front" costs of equipment. This equipment, over its technological life, is expected to enhance productivity. In a utility, capital expenditures are evaluated in terms of revenue generating potential. Examples of capital expenditures include those for switching facilities, cable plant, satellite and microwave transmission facilities, network operations centers, communications rooms, telephones, and local area network hardware and software.

Financing options for covering capital expenditures within a university include the following:

- "off-the-top" allocations for specific projects to the communications utility;
- sponsored development funds from vendors, public agencies, and foundations;
- borrowed funds.

Reallocation of monies within a university may be the first choice for financing an investment in communications facilities. Most computer procurements are financed this way. However, there is little tradition for squeezing large amounts of money out of scarce university resources for communications projects. Newly established university communications organizations may find the competition for funds extremely intense.

Notable examples of sponsored development of a portion of required communications facilities include the University of Pittsburgh's "Campus of the Future" project, and projects at MIT, Carnegie-Mellon, and other universities. These projects have in common the considerable leverage of already established communications development efforts. The communications industry is quite competitive. Universities have the opportunity to use resources (personnel, funds, networking expertise, etc.) committed to projects and that competitive market to create joint development and sponsored development opportunities. Figure 1 summarizes current sponsored and joint development communication projects at Virginia Tech.

Figure 1: Sponsored Projects: FY 87/88 - FY 88/89

These are the current development projects which go beyond the ongoing effort to administer the communications utility.

Virginia Research Network: Funded by the National Science Foundation, for approximately $240,000. among researchers within the state, as well as providing access to external computing resources.

Computer and communications vendors are sponsoring multi-faceted joint development projects with Virginia Tech, providing over $2,400,000 in funding and equipment. The areas being investigated include:

- **Network Administration/Operations Center - This project involves developing a highly-distributed network administration center, to handle all of the facets of administration of a large-scale data communications, telephone and cable-TV company.**
- **Bridges and Backbones - Virginia Tech, in cooperation with product development laboratories, is investigating methods to create "bridges" between separate networks, as well as methods of developing a campus-wide "backbone" to tie all networks on campus together.**
- **The Electronic Library - Investigating ways of providing enhanced, remote access to libray services.**
- **Satellite Communications System Test Bed - The initial projects are to develop facilities for remote operation of the Virginia Tech - Corporate Research Center Teleport and to test a bridge linking two 802.5 networks.**
- **Electronic Mail for Every Student - This project is intended to create an electronic mail system that can be used by every student, faculty member, or administrator, regardless of what computing system they choose to use.**

Several alternatives exist for borrowing funds. These options are discussed below. The debt service on the borrowed funds could be paid from an annual "off-the-top" allocation of funds by the institution or as an annual operating cost recovered through fees to users.

Borrowing Alternatives

Because of the highly competitive communications market and the attractiveness of the college and university market, many vendors offer extraordinarily attractive financing options as a part of a major communication procurement.

Alternatively, newly established university communications utility may be to borrow funds from the institution or from a foundation associated with the institution. This second option becomes especially viable if a strong business case can be developed showing full recovery of the investment in a reasonable period of time and at a reasonable interest rate. The initial development projects by Virginia Tech's communications organization were financed in this manner. The University's finance and budget organizations have been extraordinarily innovative in obtaining funds for this purpose.

State institutions may have revenue bonds as an available financing option. This is the financing method chosen by Virginia Tech for its most recent communications projects. In gaining the support of the state for this financing, a strong business case had to be developed for each of the projects. These business cases were required to reveal realistic projection of capital and operating costs. They were also evaluated in terms of the reasonableness of revenue projections. In Virginia, "reasonableness" means extraordinarily conservative - a standard with which, in this case, we were very comfortable.

We borrowed $16 million via revenue bonds. We have been asked, "Doesn't this limit the technological choices available for the communications utility? Why didn't you borrow more?" The answer to the first question is that we are always constrained by what we have to spend; however, our job is to maximize what we get for that $16 million. The answer to the second question is that current expenditure streams for communications services within Virginia Tech, perceived to be near some limit, dictated the amount we could borrow.

Two borrowing options should be examined further by those needing financing for communications projects. The first is a lease-purchase agreement financed through a 3rd party financial organization (e.g. annual rates at -1%). A second option, which appeared available for certain types of communications projects (e.g. the development of teleport facilities) and to private institutions, was development bond financing. We have not evaluated either the availability or the viability of these two options since the last tax reform act.

Business Cases

Virginia Tech's Communications Network Services organization is responsible for the provision of all communications services (voice, data, video) to the University community. The major goal is to provide communications services which maintain and enhance the University's leadership position in the delivery of instructional, research, and extension services. To accomplish this goal, a concerted effort has been made to maintain a "leading edge" position with respect to advances in communications technology.

By fiscal year 1988/89, Virginia Tech will have installed communications facilities which provide state-of-the-art voice, data, and video services. As noted above, these facilities are being financed by $16 million in revenue bonds.

Digital Switch

A salient component of the project is the acquisition of digital switching facilities to integrate voice and data communications over our distribution system.

Perhaps the best way to define this initiative is in terms of what individual users of the system will see and experience. Most of the current telephones on campus, including the rotary dial, multiline sets, will be replaced with modern, multibutton/multiline digital sets. Each digital set will have numerous programmable buttons allowing users to tailor the telephone for individual needs. Such needs may include the ability to have multiple lines, to hold or transfer calls, to initiate conference calls from pre-defined lists, to query voice mail messages, and many others. All of the phones will have an intercom capability, a message waiting indicator, single button speed dialing, automatic redial, and line status indicators. The entire system, with its anticipated low-cost long-distance links, will be cost recovered through the per telephone station charges and through an overhead charge per minute for long distance usage.

A primary reason for specifying digital telephone sets is to provide for simultaneous transmission of voice and data over the same communications system. One way the data connection can be provided is through a connector on the back of the digital telephone set. An obvious advantage of this feature is the ease of data communications installations.

This project is allocated approximately $9 million for the implementation of an IBM digital switch and telephone system. Some of the design, management and installation work is being performed by Virginia Tech personnel.

The business case consisted of projections of variable costs and revenues over the technological life of the switch and station equipment. In order to simplify our explanation, we are presenting numbers based on a point-in-time picture of these projections. Figure 2 shows that at that point, we will be supporting 16,700 stations - 7,700 data connections and 9000 telephone connections. The cost component of our model, represented in Figure 3, includes annual debt service, operating costs, maintenance costs, and access costs. The debt service is calculated for a $9 million investment at 6% interest for 7 years. The difference between the $1,674,000 collected and the actual payment scheduled over 15 years represents our replacement fund for the switch and station equipment. The $675,000 in operating costs are primarily personnel costs related to the operation of our network control and network administration centers. The $1,125,000 for maintenance is the estimated cost, including personnel cost, of our self-maintenance program.

For the state of Virginia to approve the revenue bond authorization request, we were required to show that revenue exceeded projected costs of the utility. For our internal analysis, we were more concerned with the projected rate we would have to charge users. Figure 5 shows a rate of approximately $22 per month per data or telephone station. Given that our projected rates for connections was less than the average rate paid for communications connections, this project passed both the "revenue" and the "rate" tests. (Note, however, that we do not actually set a rate based on an analysis of a particular service in isolation from all other services provided by the utility. The Communications Network Services Department recommends a rate to the University Controller and Budget Office, which may either approve the rate or make adjustments to it based on University needs.)

Figure 2 **Digital Switch Project** **Customers**

STATIONS:		
	DATA	7,700
	VOICE	9,000
	TOTAL	16,700

Figure 3 **Digital Switch Project**

CAPITAL COSTS:		$ 9,000,000
Annual Debt Services		$ 1,674,000
OPERATING COSTS:		$ 2,800,000
	Operations	675,000
	Maintenance	1,125,000
	Access	1,000,000

Figure 4 **Digital Switch Project** **Recoveries**

STATIONS:	16,700	
OPERATING COSTS:	Per Yr.	Per Mo.
$ 2,800,00 / 16,700	167.66	13.97
CAPITAL COSTS:	Per Yr.	Per Mo.
$ 1,674,000 / 16,700	100.24	8.36
TOTAL	267.90	22.33

Cable Plant

Another key aspect of this project is the development of a communications distribution infrastructure (i.e. cable and wire plant) that provides greater information transfer capacity. It is to be significantly less costly to maintain, and will be vendor independent with respect to digital switching systems and termination equipment (i.e. telephones, modems). The implementation of "The Virginia Tech Cable Plant Specification" will facilitate the development of local office networks and their interconnection with University network facilities. These local networks would provide megabit data transfer rates to faculty workstations. All data communications are presently recovered through a charge per data connection.

This project involves developing a long-range plan for networking, at very high rates of speed, for the entire campus. In addition, assistance and guidance will be provided to individual departments in the development of their own departmental network and the connection of that network to the University "backbone". By developing these individual networks in a consistent and standardized manner, interconnectivity will be greatly enhanced.

This project is allocated approximately $4.5 million for the implementation of the "The Virginia Tech Cable Plant Specification." All of the design and management and most of the installation work are being performed by Virginia Tech personnel at a savings of several million dollars.

The business case for the cable plant is very similar to that used for the digital switch. What is being "sold" to the customers of the utility is connections to the cable plant via an "outlet." Figure 5 shows the projected number of outlets at one point in the life cycle. It also shows the estimated costs. Our budget for interbuilding projects is $2.5 million. With about 20 percent of the projects completed, we are still expecting to be within those allocations for the entire project. Under annual operating costs, we have $90,000 allocated for personnel and material costs associated with maintaining the cable plant and $360,000 allocated for expansion and enhancement of the cable plant. The projected rate for an outlet, shown in Figure 5, is $3.17 per month. This would be added to the rate for connections to the digital switch or for a local area network connection.

Figure 5	**Cable Plant Project**	**Recoveries**
OUTLET CUSTOMERS:	TOTAL	24,000
OPERATION COSTS: (Includes expansion & maintenance costs)	Per Yr.	Per Mo.
$ 450,000 / 24,000	18.75	1.56
CAPITAL COSTS: (Annual Debt Service on $4,500,000)	Per Yr.	Per Mo.
$ 463,500 / 24.000	19.31	1.61
TOTAL	36.06	3.17

Video System

The campus-wide wiring infrastructure, the Virginia Tech Cable Plant, will include cable to all workspaces (offices, dormitory rooms, and classrooms) for video. The project will provide a rich array of video programming on this broadband cable system. Current plans are for 35 to 40 channels of programming providing access to instructional programs, teleconferences, and informational services. The video system costs are to be recovered through a charge per connection in dormitories and offices.

Video System: This project is allocated approximately $1.5 million for the implementation of a 64 channel video system. All of the design, management and installation work is being performed by Virginia Tech personnel.

Figure 6 shows the projected costs, revenues, and rate for video service. The difference between the calculated rate and the actual rate of $8 per month represents the University's subsidization of this facility. The rationalization for this subsidy is that classrooms will be provided with video facilities as part of the project. Therefore, dormitory students and office users of the system will be paying for the classroom related facilities.

Figure 6 **Video System Project**

CAPITAL COSTS:	$ 1,500,000	
Annual Debt Service	$ 279,000	
OPERATING COSTS: CUSTOMERS:	$ 540,000 5,000	
OPERATING COSTS:	Per Yr.	Per Mo.
$ 540,000 / 5000	108.00	9.00
CAPITAL COSTS:	Per Yr.	Per Mo.
$ 279,000 / 5000	55.80	4.65

Long Distance Services

With a significant degree of integration of voice, data, and video services over this University network, it is economically feasible to develop private, long distance communications links to areas strategically important to the University. For example, Virginia Tech will develop a link between Blacksburg and northern Virginia, and possibly Richmond, which could be fully utilized over a 24 hour cycle for video, data, and telephone services. Such a link will cost significantly less than the amount the University is currently paying.

Figure 7 presents one view of our analysis of the long distance services project. It reveals our expected average cost, including the recovery of capital facility costs, per minute of this service. The projected price for these services is considered reasonable given our current average price of 33 cents per minute. (Our current average rate is calculated by including the estimated cost of unsuccessful calls - no answer, busy - into the rate provided us by our primary vendor.) Excessive recoveries would be used to reduce the other communication services, such as connection to the digital switch.

Figure 7 **Long Distance Services Project**

ADMINISTRATION		6.25 million minutes +/- .94 million minutes
STUDENTS		7.29 million minutes +/- 1.82 million minutes
TOTALS		13.54 million minutes +/- 2.79
Projected Rate versus Cost:		
	Average Cost per minute	.20
	Average Rate per minute	.28
	Difference	.08
Potential Surplus Recoveries:		$ 1,083,000 +/- $ 223,000

Satellite Transmission Facilities

The Virginia Tech - Corporate Research Center Teleport, now consisting of a 9 meter C-Band transmit/receive earth station, is being expanded to include two additional facilities: a multi-feed receive-only earth station, which will receive programming to be distributed over the new Virginia Tech video system; and a KU-Band transmit/receive earth station, which will be utilized, experimentally, to provide communications capability to Northern Virginia, as well as by the Satellite Engineering group in the Electrical Engineering Department. This project is allocated $1 million. Also, a feasibility study is underway for the development of a Blacksburg - Europe link via an Intelsat satellite facility.

Five year life cycle costs for our C-band transmission facility are summarized in Figures 8 and 9. The service being sold is video transmit time in hours. We transmit graduate engineering and other courses, programs supporting our extension mission, and private sector transmission such as athletic events. Our actual usage for the past year was within 10 percent of the model projection (Figure 8). Figure 9 shows the required revenues and the calculated rate per hour for the facility. The 5-year average rate is consistent with the market price for such services. Our actual cost projections were high by about 15 percent. Also, we now are convinced that a seven year life cycle would have been appropriate, further reducing the the potential rate.

Figure 8 RATE MODEL: C-BAND TRANSMISSION FACILITY

Usage Forecast

	86/87	87/88	88/89	89/90	90/91	TOTAL
Instr	720	810	900	990	1080	
Test	60	72	72	72	72	
Total	780	882	972	1062	1152	4848
Other Public	180	270	383	589	943	
Private	30	45	90	120	120	
Sub-total	990	1197	1445	1771	2215	7618
Overhead	248	299	361	442	554	1904
Total	1238	1496	1806	2213	2769	9522

Figure 9 RATE MODEL: C-BAND TRANSMISSION FACILITY

Rate Calculation

	86/87	87/88	88/89	89/90	90/91	TOTAL
Personnel	$36843	$46774	$59268	$68930	$72378	$284193
Other Direct	$73456	$75606	$77864	$80234	$82723	$389883
Indirect	$5122	$5895	$6839	$7609	$7989	$33454
Depreciation	$127520	$127520	$127520	$127520	$127520	$637600
Total	$242941	$255795	$271491	$284293	$290610	1345130
Hours	990	1197	1445	1771	2215	7618
Rate/hour	$245/hr	$214/hr	$188/hr	$161/hr	$131/hr	$177/hr

Conclusion

Through the careful restructuring of the funding methods for current communications services, the aggressive use of financing options, and the application of comprehensive development plans, communications costs for an institution with a communications infrastructure that reflects the latest in available technology do not necessarily have to increase. Figure 10 shows our proposed rates for fiscal year 1989-90 for services based on facilities currently being implemented at Virginia Tech. Will departments be paying a smaller portion of their budgets for communications services? With our improved capabilities we think that current total communications expenditures will actually increase. This is because some departments do recognize the relationship between their competitiveness and their ability to transport information.

Figure 10 **Rates for Service**

	Market/Current	Proposed
TELEPHONE	$ 33	$ 25
DATA	$ 25	$ 20
VIDEO	$ 14	$ 8
Long Distance	.33/minute	.28/minute
CBand Transmit	$225/hour	$150/minute

References

Blythe, Erv, "The Cutting Edge of Network Technology," CAUSE/EFFECT, Jan. 1986.

Chew, Robert, "Value-Added Network Services For Universities," CAUSE/EFFECT, Mar. 1987.

Lilly, Judy L., "Organization for Communications Network Services," CAUSE/EFFECT, July, 1985.

Kumar, Prem, "Telecommunication Planning," Graduate School of Business, University of Pittsburgh, July 1987.

Toner, Michael A., "Why Do Nothing With Your Telephone System Will Be Expensive," CAUSE/EFFECT, May 1986.

Track VI

Hardware/Software Strategies

Coordinator:
Frank Weiss
Barnard College

Planning and successfully implementing information technologies in academic and administrative environments require both short- and long-range strategies for hardware and software, spanning personal computers and supercomputers, spreadsheet packages, and fourth-generation languages. Papers in this track examine such planning strategies, implementations, and successful programs.

Mary Lawarre Cox
Wittenberg University

Leonard M. Brush
Carnegie Mellon University

Morris A. Hicks
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"INTEGRATED SYSTEMS - THE NEXT STEPS"

Morris A. Hicks

Associate Director
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ABSTRACT

The University of Hartford had the necessary infrastructure in place to capitalize on its investment in four major integrated systems, when the current data base vendor and application software vendor joined to offer a package of software products. Project goals were to upgrade to an advanced relational data base management system, to provide on-line management summary inquiry facilities and a new query facility for direct on-line access by end users, and to install a fourth generation language. Since this would be the first installation of these products in an operational environment, flexibility of plans and execution would be required.

The value of having a solid foundation of stabilized systems, experienced staffs, commitment of management, flexible planning, and staff training is emphasized. Experience of migrating existing systems, conversion of the data bases, and impact upon computer operations will be discussed.

"INTEGRATED SYSTEMS - THE NEXT STEPS"

Introduction

In the early 1980's, the University of Hartford initiated a review of administrative systems and undertook the strategic project to install a series of advanced, integrated information systems. During an 18 month period, four administrative systems were installed. These systems were the accounts receivable (ARIS), human resources and payroll (HRIS), financial information (IFIS), and student information (ISIS) from the selected vendor, Systems and Computer Technology or SCT. About a year and a half later, these systems had been stabilized and the necessary infrastructure was in place and so that the University could consider a opportunity to capitalize on its investment.

The opportunity focused on three areas: accessibility of data by management, replacement data base management system, and tools for easing the application system back log. The application systems had become integral to the operating departments but had not sufficiently satisfied the management information needs. The data base technology to allow secure access to the information was one need for an advanced data base management system. Another was that the current data base management system, TOTAL, was in a "maintenance status" and had to be replaced in any case.

The project goals were to install an advanced relational data base management system (SUPRA), an on-line management query system (part of Symmetry), a new query facility (SPECTRA) for direct on-line access by management personnel and a fourth generation language (MANTIS) for analysts and programmers.

It was recognized that this would be the first project of this type in a production environment and therefore flexibility of plans and execution would be required. The solid foundation of operating experience and expertise of systems professionals and of management and supervisory end users was essential. The importance of experienced administrative and operating management in user departments must be emphasized. Not only were they very knowledgable in understanding their systems but also in system implementation projects. This first hand experience was a key resource in pursuing a very progressive project plan. They had successfully completed larger, more difficult projects before and so knew what to do and what trials and frustrations to expect.

This paper focuses on the process of planning and execution rather than on technical details and broader institutional issues.

Background on the University of Hartford

The University of Hartford is an independent, comprehensive university which provides educational programs in the liberal arts and professional disciplines for undergraduate and graduate students. There are 155 graduate and undergraduate majors and degree programs. Most of the 4,200 full-time undergraduate students come from the northeast part of the United States. In addition there are 7,000 others enrolled in part-time undergraduate and graduate programs and noncredit courses.

The University campus is situated on a 230+ acre suburban setting in the greater Hartford area and has practically all of its facilities (colleges, dormitories, and administration buildings) on this contiguous piece of land.

Computer and Human Resources

In recognition of the University's investment in its integrated information systems, the computer resource had been upgraded to an IBM 4381 (MVS operating system) with 130 terminals for the administrative users and the systems staff had been expanded and highly trained. Particularly important was the staffing in the application systems area, where a relatively small staff had attained a high level of expertise. This expertise was evidenced by the growing number of vendor supplied enhancements placed into production.

Equally important was a knowledgable and experienced community of end users. A large number had participated in the original installation of the information systems and now used them in an operational environment.

General Objectives and Goals

With this foundation, the portfolio of information systems could then be viewed from a longer term and more flexible perspective as to what would be the next steps to build upon the institution's investment. The general goals were to enhance and improve the installed application systems and to build upon these systems and provide new strategic components (including direct access to the on-line data). The investment in the information systems could be leveraged by increasing the scope and increased strategic use of the information resources.

The paths to accomplish these objectives were many. For example, vendor and in-house enhancements could be installed one by one to each of the systems or the current baseline software could be installed. A replacement data base management system was also a part of future plans.

Status of Application Systems

The four major information systems were advanced, integrated, on-line and batch applications from Systems and Computer Technology (SCT), that had been adapted to the University's environment. These adaptations varied from system to system. All of the systems had become an integral part in department operations.

Major Administrative Application Systems

Account Receivable Information System (ARIS)

Human Resources Information System (HRIS)
(human resource department functions, payroll)

Integrated Financial Information System (IFIS)
(fund accounting, budgeting, accounts payable)

Integrated Student Information System (ISIS)
(admissions, registration, financial aid, course catalogue, fee assessment, housing, academic history)

In reviewing the portfolio, a number of aspects were investigated. Some of the more important areas were:

Application Systems Portfolio Review

Adaptation - Degree of adaptation versus vendor's current baseline

Stability - Comparative stability of the information system

Data Structure - Data structure for each information system ("TOTAL" DBMS or VSAM files)

Functionality - End user conclusion on the functionality of the current system as compared to the current baseline product

Enhancements - Implementation of the vendor supplied enhancements

Alternative - Feasibility and project estimates

While the level of expertise of the applications staff allowed a significant number of vendor supplied enhancements to be installed, the number of enhancements varied from system to system. In particular the human resources system (payroll portion) did not have the smooth operation that permitted enhancements to be installed. Too many resources were diverted to handle the day to day operation of this (HRIS) system. With the excellent institutional foundation in both trained personnel and information systems, consideration could be given to upgrade certain systems to the most recent releases and thus bypass the enhancement by enhancement process.

Another candidate was the Accounts Receivable system (ARIS); however the extent of adaptations gave pause to the consideration of upgrading that system for the time being. The financial system (IFIS) was the most stabile of the systems. However IFIS was not the TOTAL version as were all of the others but the VSAM version. The largest system of the four systems by far was (and is) the student information system (ISIS), which was stabile and had a number of major enhancements installed. For ISIS, the Tuition Assessment portion had been greatly expanded by the University to provide a very flexible tuition and fee assessment module.

Major Long Range Plan Components

It is well to note the difference between an upgrade to a baseline and an installation of a software product for the first time. First time installations are massive projects when compared to the upgrade of existing software within a product line. In this context upgrades are updates and extensions, which are unlike first time installations.

Of the systems, the human resources/payroll (HRIS) system was the most logical candidate for an upgrade and this project was begun in 1986 and finished in early 1987. The next most logical candidate for upgrading was the financial system (IFIS), but equally important was a replacement data base management system (DBMS).

Component	Possible Plan - Current Status
Accounts Receivable (ARIS)	Upgrade to baseline - Deferred
Human Resource/Payroll (HRIS)	Upgrade to baseline - Completed
Financial System (IFIS)	Upgrade to baseline - In progress
Student System (ISIS)	Major enhancements continuing
Data Base Management System	Replacement DBMS - Completed
Query Facility and 4GL	Installation - Completed

Data Base Management System - TOTAL to ?

The data base management system being used to support the installed SCT systems was TOTAL from CINCOM Systems. This was a stable, "work horse" product; however it was an older technology that was destined to be superceded. Long term planning recognized that a new data base management system (DBMS) would have to be installed. It was also recognized that the currently installed TOTAL DBMS product had been highly tuned over the last few years. Furthermore, it was much simpler in operation and in performance tuning than any of the newer relational data base management systems being considered as replacement candidates.

There were a number of major areas of comparison for a prospective data base management systems (DBMS). The data files, the job control statements (JCL), and the programs required a careful review of their migration options and risks associated with each candidate DBMS. This was especially true since neither the existing staff would be increased nor were there to be large expenditures available for contract programming support.

Training of the Computer Services staff would need to be done before the installation of any new product. Timing of any move to production would need to be considered very carefully as to allow for the majority of the work to be done outside of the heavy usage periods in the academic calendar and to allow for substantial tuning of any new DBMS before the next such heavy usage period occurred.

DBMS Selection Criteria

Experienced Product - To be a proven product with a significant number of sites in production with COBOL programs.

Migration - To migrate with ease and security to the new environment as well as the flexibility to return to the old.

Program Changes - Not require logic changes to the existing application programs.

Functional Transparency - No end user training required.

Performance - To be at least as good as with the current DBMS.

Advanced Relational Technology - To provide immediate benefits while providing a basis for the future.

Ad Hoc Query - To allow direct access by end user staff, while maintaining confidentiality and integrity of the data base files.

4GL - A fourth generation language (4GL).

Thus, as the list indicates, there were a large number of important "nuts and bolts" to be concerned about in actually implementing a change in the DBMS - not to mention the very important long term institutional objectives for the application systems and increased utilization of the information resource.

The SUPRA/Symmetry Package

Fortuitously, the current application software vendor (SCT) and the current DBMS software vendor (CINCOM Systems) forged a joint program to offer a package of an advanced relational DBMS and an Administrative Inquiry system designed to fit within and build upon the University's existing application software base and data files. University management reviewed this opportunity and was positive in its conclusion.

SUPRA, the new advanced data base management system from CINCOM, had already been identified as one of the prime candidates for the next DBMS and had scored high in the selection criteria. SUPRA is one of the leading advance technology DBMS's and comes with a fourth generation language (MANTIS) and an ad hoc query system (SPECTRA). SUPRA passes data defined by external schemas or data "views"; these data "views" can be defined for each end user and have security to the record and element/field level. Since TOTAL is also CINCOM's product there is a high level of support for migration tools and conversion guidelines. Another plus for SUPRA was that it was already installed in the local Hartford area at a number of commercial sites. In fact one of the companies had been a "beta" test site for SUPRA. Discussions with local SUPRA users indicated that the product was very favorably regarded. It was stated that application programs need to have only non-logical changes done, since SUPRA supports the existing COBOL TOTAL statements. In summary, SUPRA is a proven advanced DBMS that has a flexible migration path as well as a number of implementation options.

On the application side, the software vendor (SCT) offered an on-line Administrative Inquiry System using MANTIS (the 4GL), which utilizes the technology of SUPRA to access the production data on-line and produces management summary information. Our implementation would be the first in which the SCT products would operate with SUPRA in an actual production environment. It was expected that there would be unknowns, but, with the experience of other sites and the tools available from CINCOM, unexpected problems to be encountered were judged to be a very low risk. Further more, in case of a catastrophic event, there were CINCOM utilities to return us to the original TOTAL environment. As the first site to use this project package, there would be significant vendor (SCT) support also provided.

SUPRA/Symmetry Project

The accounts receivable (ARIS), human resources (HRIS), and student system (ISIS) were to be a part of the migration to the new environment, while the financial system (IFIS) was deferred because it would require both an upgrade to the TOTAL version of the IFIS software as well as a migration to the new SUPRA DBMS. This decision was based on the recent upgrade experience of the human resources system, the first estimate of the project requirements, and the resources available. The upgrade and migration of the financial system was positioned after the completion of the SUPRA/Symmetry project.

The time frame for this project was to begin after the end of the spring term processing (end of May) and to accomplish practically all of the work before the fall registration period (late August).

Framework Planning

Starting at a high level perspective, the project components were identified and then broken down into further details. Due to the uncertainty in a number of areas, flexibility in implementation was to be a keystone for achieving goals - a "framework" project plan.

The major project components were specified and alternatives to achieve these components were laid out. The testing and evaluation of the implementation alternatives were an integral part of the project. Decisions based on these evaluations and recommendations would ultimately determine the final implementation path for each major project component. This approach allowed progress both in the overall project and in the investigation of the implementation details for the project. In a number of cases the work from one project component helped refine the alternatives in another component.

Our first important task to be accomplished was the training, by CINCOM, of the professional staff - data base specialist, systems analysts, analyst/programmers, and data security administrator. The data security administrator was to be the backup for the data base specialist and there were also a number of features of SUPRA that touched upon the area of controlled access and security of the production data.

Major Project Planning Areas
Staff Training
Data base conversions
Program conversions
Production job conversions (JCL changes)
Operational modes of SUPRA
Management Summary Screens (Symmetry products)

Computer Services staff training was a key task and was the first to be accomplished. Analysts and programmers were trained in Mantis, which is the new 4GL and the development language of SCT's Administrative Inquiry System (part of Symmetry). The data base specialist and data security administrator completed the recommended training in the technical aspects of SUPRA.

Data Conversion Paths

Early considerations as to which path to take for migrating the current data touched upon a number of issues, such as ease of accomplishment, assurance of success, and minimum resource requirements. Data conversion considered two aspects - physical data "structure" (or internal schema) and logical data "design" (or conceptual schema). For purposes of discussion in this paper, data "structure" is the physical placement and accessing of the data by the DBMS, while data "design" is the result of a data analysis and normalization process. Only the data "structure" was included in this project, since the data files already existed and the normalization process would be a major project itself. Most importantly, this normalization process did not have to be accomplished in order to achieve the project goals.

Since the data was in the TOTAL data structure, there were CINCOM utilities provided to convert the data to the new SUPRA data structures, which I will describe as "converted" and "native". The "converted" structure was a quick, safe intermediate step, but did not provide the operational performance of the SUPRA native data structure. The path to SUPRA "native" data structure would take much more time and would be more difficult to return to the TOTAL data structure in case of a major problem. Choosing the "converted" path meant that, for the short term, performance of all the data base application systems would be adversely affected and additional tuning would be required.

Operational Options

The IBM 4381 computer used solely for the administrative applications utilizing the MVS operating system and the on-line system software (CICS) presented certain operating limits for implementing SUPRA. It is not the purpose of this paper to go into technical details; however part of the implementation plan did investigate and resolve these technical issues. The following brief discussion will, hopefully, clarify the issues and present the findings from the tests and the final conclusions, which were that SUPRA would operate within the existing computer resource limits and that the selected "mode" of operating SUPRA for on-line applications would be different from the "mode" selected for batch processing.

Only two of the four operating modes for the physical data manager ("PDM") component of SUPRA were considered after initial investigations. One mode is called "central" where only one copy of the PDM is needed for a number of address spaces - in contrast with TOTAL which requires a copy for each address space. On the other side was the "attached" mode where, like TOTAL, a copy resided in each address space.

There was much concern about the CICS region address space requirements for all of the new SUPRA products (Data managers, Mantis, Spectra, other utilities). The only way to increase the current address space limitation of 16 megabytes was to move to the MVS/XA option. This would have been a project itself and would have cause the postponement of the SUPRA/Symmetry project.

Experience at other installations and our in-house testing demonstrated that there was sufficient address space for all the software required. While "central" mode would require higher operating system overheads for on-line processing, less address space would be needed for the SUPRA software packages. For production batch processing, where address space was less an issue, the "attached" mode would be used to achieve maximum performance.

Program Conversions - Major Concern
Conversion of existing production programs was considered to be the area of most concern, since both changed programs and data would significantly increase the effort in testing and degugging. Although SUPRA was a tested product, this would be the first time that these production programs would be put into a real operational environment under SUPRA. From the perspective of the origin and language of the production programs, the following categories of programs were to be investigated and modified as necessary to achieve projects goals.

Program Categories for Conversion

Baseline Programs - COBOL vendor programs substantially unchanged from the vendor's original baseline (SCT)

Modified Programs - COBOL vendor programs modified at the University

University Programs - COBOL programs designed and programmed by the University

Other Programs - Non-COBOL programs written in other languages, such as Easytrieve and Socrates (an old CINCOM product)

All of the programs used in the SCT integrated systems were written for TOTAL and the degree of conversion for running with SUPRA was a major issue. To take advantage of the SUPRA technology for our objectives, only minimal revisions of the COBOL programs were required. Based on vendor information and our investigations, it was determined that about 11% of the approximate 1,100 programs in the program library needed minor changes. The non-COBOL programs proved also to be relatively easy to convert; although the old CINCOM report writer (Socrates) programs proved to be a more of a problem and all of them were rewritten.

Job Conversions - JCL Changes

With utilities that were written in-house, the Job Control Language (JCL) statements were easily changed for all of the production batch jobs, although a few minor problems did crop up. An unexpected benefit was that the library space needed for the JCL decreased by a factor of 5, because the JCL information for the data base files now resided within the SUPRA directory.

The Unexpected - As Expected

As expected there was the unexpected. Many of the unexpected events were positive. The installation of SUPRA and the Administrative Inquiry System went without major incident. Testing of the data conversion utilities and of the restoration of the old TOTAL data structure went relatively smoothly. Address space limitations were not a problem as first anticipated.

There was a handful of exceptional program changes required to accommodate the different handling of certain functions and status codes between TOTAL and SUPRA. Some examples are changing exclusive updates to shared updates, serial read of variable (related) file, and the status code returned with the "RDNXT" (read next) command.

SUPRA is a much more sophisticated DBMS and therefore is more complicated. Data integrity and schema architecture have many benefits; however they do require more resources and longer times in the implementation phase. Although the data base specialist had training as the first step of the project, the actual tasks he was performing were taking much more computer processing times than anticipated. As a result, more judgement was required for assessing implementation alternatives and less comprehensive testing for every phase was possible in the project time frame. Each combination of the alternatives for testing needed significant effort to finish the exploration and analysis.

Independent Major Alternatives

Data Structures - Five Data conversion utilities between the three data structures, (TOTAL, SUPRA "converted" and "native")

Application Job Libraries - Batch and On-line applications for converted and original versions

Data Bases - Two test data bases - "small" and production copy

Modes of SUPRA operation - "central" and "attached"

A judicious pruning of the alternative tree occurred based on vendor recommendations, the experience of other sites, and most importantly our own growing experience. One of the conclusions was that the "converted" data path be selected due to time and risk considerations, although this would imply an initial lower performance level.

Because of the significant lengthening of accomplishing data base tasks, it was evident that the DBMS tuning and population of secondary indices would also take longer than originally expected. However, implementation would occur after the busy periods in the academic calendar so as to allow time for the first round of tuning, which would achieve 80% of the desired results before the next busy period.

Completed Project Paths and Experience

The actual project path was achieved on September 19, when SUPRA was moved into production. The data was converted to SUPRA "converted" data structure; the programs with TOTAL calls were changed where necessary and others rewritten; production jobs had the JCL changed for SUPRA; SUPRA was implemented in the "central" mode for on-line programs and in the "attached" mode for batch jobs. As a result of all the preliminary work and testing, the final tasks of moving to production and verification took 13 hours.

The University's integrated systems have been operating with SUPRA since that time. The move has been functionally "transparent" to the user, which, in this case, was very high praise for a job well done.

Conclusion

The early planning recognized the uncertainties in the project and the benefits of making progress at the same time while evaluating implementation alternatives. The University had a firm foundation of end user expertise, up-to-date computer resources, information system professionals, and a commitment to build upon the information systems investment it had made over the past few years. Key to this effort was the first completed task - training. Subsequent tasks used and built upon this base and the University's foundation in information systems experience. The "framework" plan worked well for this type of project in this institutional environment. If there been time to completely investigate the implementation alternatives, a different path may have been chosen that would have saved time in subsequent tuning and data conversion. The success of the project resulted in the University achieving another milestone along the strategic road to capitalize upon its investment in integrated systems.

Administrative Microcomputing
Roads Traveled-Lessons Learned

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Abstract: Microcomputing, now a traditional part of the academic computing environment, can also be an important component of the provision of administrative computing services - but there are associated dangers. By following some simple strategies many of the benefits can be realized while minimizing the risks to the integrity of institutional information resources. Such has been the case at Hamilton College. The planning decisions that were made, results that were obtained, lessons that were learned, and disasters that were observed, are useful for other institutions considering desktop computing as an addition to the use of mainframe/mini based systems for administrative support.

The personal workstation, embraced as a productivity tool and heralded by some as the answer to the improvement of instruction, has had a harder time finding acceptance in administrative offices. Among the concerns about micros expressed by those responsible for managing administrative computing services are: loss of data integrity resulting from offices maintaining their own data bases, and the loss of control over the selection of hardware and software with the resulting incompatibility of equipment and data.

While not a replacement for centralized mini or mainframe based systems necessary for shared data bases, microcomputing can provide an important supplement to such resources, and help the institution make more effective use of its administrative computing dollars. Our experiences at one small college provide insight into the potential benefits, requirements, and liabilities of microcomputing.

Historical Perspective

Hamilton College is a private, coeducational, liberal arts college of 1600 students, located in upstate New York. While the institution has many traditions, going back to its chartering in 1812, its history with respect to administrative computing is relatively short. Prior to 1974 all data processing was done on unit record equipment. The punched card was king and data redundancy the norm. The College acquired its first administrative computer in 1974, a 32K machine with 10MB of removable disk storage, which provided batch processing for *all* major administrative offices until 1980 - a truly remarkable feat given the power of the systems that sit on desktops today! During this period the card was still at least a prince, but data redundancy was brought under control.

In 1974, two critical decisions about computing spurred our use of micros. The first was our decision to use the Cornell mainframe (then an IBM 370/168) for large scale academic computing rather than purchase our own mini or mainframe. Not having to directly support such a system we were eventually able to devote most of our energies to integrating the microcomputer into our instructional program. Second, our computing services organization would serve both the academic and administrative computing needs of the College. Thus support personnel developed expertise in the use of micros as soon as they were used in the classroom. Further, advice for hardware and software selection was provided by the same individuals. Table 1 indicates our current distribution of microcomputers in administrative offices.

Table 1
Microcomputers in Administrative Offices

Office	Number of PCs	Office	Number of PCs
Academic Depts*	11	Financial Aid	2
Art Gallery	1	Health Center	1
Bookstore	1	HEOP Office	1
Campus Center	1	Library	6
Business Office	2	Personnel	1
Career Center	2	President's Office	3
Computer Center	3	Registrar	2
Dean of the College	4	Security Office	1
Dean of Students	2	Summer Programs	1
Development	1	VP Finance/Administration	1

*some offices serve several departments

In 1980 Hamilton retired its original batch-oriented minicomputer system and obtained a multiprocessing system, with a view towards going "on-line". At just about the same time microcomputers had gained acceptance by the academic community, with the first applications being simple drill and practice, simulations, and word processing. Even the crudest of word processing systems on microcomputers showed great hope for addressing some of the basic needs of the faculty and administrative offices. But could they do more for administrative users?

Some strategies

While the initial foray into desktop computing was largely experimental and unplanned it soon became clear that managing the growth of administrative personal computers was necessary if chaos was to be avoided. Several strategies were devised to this end. In the remainder of this paper we describe the strategies and the results obtained.

Standardize hardware and software configurations used in offices.

Academic use of microcomputing necessitated a "controlled diversity"[1] of hardware and software, with hardware decisions driven by instructional software needs. This led to the support of three major operating systems MS-DOS, Apple DOS, and the Macintosh. We felt that it was important for data sharing and software support of administrative users that **one** hardware/software configuration be selected for administrative offices. The selection was based on two main criteria: availability of a variety of software packages for word processing, spreadsheets, and file manangement, and the existence of a file transfer and terminal emulation program that would work in concert with our on-line administrative computing system. Based on these criteria we selected the MS-DOS environment, as implemented on the IBM PC.

We selected Multimate for word processing, Lotus 1-2-3 for spreadsheet applications, and PC-File/R for file management. The communications package we used was supplied by the vendor of our on-line administrative system software and features flow control for data transmission, and cursor control for terminal compatibility. Each of these packages was selected on the basis of the criteria of *sufficiency* to meet the needs of most of our users, and simplicity of use. Further, attention was paid to the ease of providing training and support for new users.

The standard hardware configuration is a 640K machine with two floppy disk drives, serial and parallel ports. Users needing mass storage capabilities use the removable cartridge disk technology which provides a simple, and fast built-in backup system. One type of 24-pin matrix printer, one type of full character printer, and one type of laser printer are supported. This simplifies the problems associated with interfacing printers, hardware, and software.

By selecting one hardware/software configuration we simplified hardware and software support activities. Training courses are run periodically for employees and employees trained in the use of the software can move from one office to another and immediately be productive. In addition, the body of trained users serve as an extended support organization - often users can find the answers to their problems by consulting other users. In addition, faculty that use the same hardware and software can exchange information readily with secretaries for document preparation. The existence of a "standard" configuration has encouraged some faculty to make purchase decisions for personal systems in ways that simplify their work.

It should be pointed out that the most important aspect of the above strategy was the selection of **one** hardware and software configuration, not the particular choice of the representatives of that selection. Since the selection period we have had reason to wish that we had originally made some different choices, but we have never regretted the fact that we standardized on **one** system for administrative use.

Simplify the workstation operating environment

Even in an environment of homogeneous hardware and software much can be done to simplify the operating environment of office employees. For example, we built a front-end menu for all users of workstations with hard disks (figure 1). In this way novice users are able to avoid the complexity of dealing with tree-structured directories that are necessary for organizing computer files efficiently. In addition, by maintaining a consistent approach to developing these menus we were able to easily modify them as users licensed additional software.

Sample Menu

1. Multimate Word Processing
2. Lotus 1-2-3
3. PC File III
4. Connect with Cornell
5. Connect with NCR
6. Connect with Typesetter
7. Thinktank

9. Backup Bernoulli Cartridge

0. Return to DOS

Your Choice?

Figure 1

We make extensive use of batch files of operating system commands to minimize complexity for the user. For those users with the floppy-disk based systems we have utilized a start-up disk which contains all workstation configuration information (e.g. printer setup, file setup, clock/calendar access) as well as operating system software. Thus we avoid having to put this information on each software disk and simplify the process of making changes to the workstation environment.

Work diligently to avoid data redundancy

The use of file management software can lead to the propagation of data redundancy as offices attempt to maintain information that is also part of the central data base. For example, an office might decide to maintain its own mailing list of employees. Since there is no direct connection between the two data bases, and each can change dynamically, the inevitable result is a duplication of effort and inaccurate information. How is this to be avoided?

Education is the most important factor in avoiding data redundancy. Offices must understand that they have an interest in keeping the centrally shared data base accurate, and that information to be shared among offices must be maintained centrally. Office-specific information is appropriately maintained on the personal workstation. For example the following data bases are among those maintained on personal computers: parking fines and car registrations (in the security office), work orders (physical plant), computer equipment inventory (computer center), cable pair assignments (telecommunications), faculty publications (library), patient visits (health center). In each case the information in question is primarily of value to the office that maintains it. That office might share information with others through reports, but other offices do not need direct access to that information.

Even in the above examples data bases often contain components of information that are available centrally. How is the office to avoid rekeying that information? We make use of the ability to download information from the central system to the office data base. For example, the auto registration data base must contain the name, ID, residence and class year of each student. This information is downloaded to the data base at the start of the academic year. Then the information about auto registrations, including the assigned decal number, is added to this base of information to provide the necessary data base used in assessing fines for illegally parked cars. Periodically, the security office can provide a list to the billing office of those individuals that are to be billed for fines. The listing contains the ID numbers of the offenders, eliminating the need for the information to be further modified for billing purposes.

Avoid programming applications on personal workstations

We have selected software that does not require users to write programs to accomplish work on personal computers. For example, we chose a file management program that does not require any user programming to maintain simple data bases.

The main problem with user-developed software is the increased potential for undocumented and unsupportable administrative applications. Such applications, if they are important to the operation of an office, introduce a hidden liability to the administrative operation of the institution. Changes in personnel can mean a crisis situation.

However, the situaton would be different if the central computer services organization can provide the programming services and support. Under these conditions the personal workstation becomes merely an extension of central computing services. This was not the case at Hamilton, so we *tried* to avoid such applications.

Some successes

What has been our actual experience with the above strategies in a small college environment? First some modest successes.

The Personnel Data Base

The College has a Personnel Office that is responsible for most aspects of employee relations, including benefits administration, and position management. While our payroll system efficiently processes the financial aspects of the payroll, it is a batch-oriented system that was designed for a different era. It contains a personnel biographical component, and information for any employee can be looked up on-line, but it lacks the flexible reporting capability necessary for our Personnnel Office. For some time we have considered implementing a new payroll/personnel system that would provide this flexibility, as well as additional information management capabilities.

As an interim step we designed a system that was based on PC-File/R. Periodically, usually about four times each year, we download information from our central system to create a personnel data base. Once the information is under control of the file management software, the Director can produce the reports she requires. The system has been successful enough that we have postponed our consideration of a new centralized system for the last three years. Each time we raise the issue, the Director indicates that she does not see a substantial benefit to the new system over the approach she currently uses.

Health Center Patient Visits

Our Health Center handles over 9,000 patient visits each year. In order to plan for the provision of services it is necessary for the Center to be able to collect data on the type of services it provides, in particular, the number of individuals treated for various illnesses and the personnel providing treatment. We developed a PC-File/R application that allows this information to be entered on a daily basis. The Health Center has access to this information at all times in electronic form. In addition, an extract file is created at the end of each month that is transmitted to Cornell's mainframe for statistical analysis. The combination of a PC based application and the monthly statistical analysis provides important information for planning and management of the Center.

Application Packages

Our Campus Center has licensed a software package designed for the room reservations and other aspects of the Center management. The system was designed by a campus center manager at another institution and is now marketed nationally. It is well documented, support is provided by the vendor, and it operates on our standard hardware configuration.

The acquisition of such software is a wise use of funds. Our computer center personnel support the hardware, and other software used on the system, and assist in implementing updates provided by the vendor. The Campus Center was thus able to acquire an application package that we did not have had the time to develop in-house.

Some modest disasters

All things do not work out the way they were planned. Some disasters were also observed during the last several years. Doug Van Houweling's principle that "it is not a bad thing to have a small disaster in progress at all times"[2] is one worth remembering when implementing any strategy.

Incompatible environments

In spite of the best of intentions incompatible equipment sometimes arrives on campus. Our most notable instance occurred when the chair of an academic department decided that the departmental secretary should have the same kind of microcomputer he used at home. He was able to circumvent the purchasing process and the equipment arrived on campus and was used. The secretary who used the equipment was not able to exchange information with other offices on campus, and numerous annoying incidents occurred over the next three years, finally culminating in the replacement of that machine and the conversion of all documents to the standard software (at the expense of hiring a person for an entire summer). The original equipment now sits idle, with only one person at the College knowing how to use it.

Not all incompatibilities in administrative offices arise from deception. Some are the natural result of the need to serve academic departments that use other hardware in connection with the instructional program. Thus we have several academic departmental offices whose hardware/software is other than our standard configuration. In these cases we have developed limited file transfer capability between the machines being supported on campus. The situation is not ideal, but necessary.

The user who knew too much

We had one situation in which a user who had learned some programming decided that he would develop a system for his office. The project required that numerous Basic programs be written. We approached this project with great caution. On one hand we did not have the expertise to develop the applications ourselves on the PC, nor the time to program them on the central system. The application certainly seemed do-able on a PC but we had concerns about the quality of the programming, documentation, and office procedures that would result. The system would replace the data input from our physical plant for our weekly payroll, so there were potentially significant benefits, but also significant risks. We finally agreed to allow the project to go forward as an "experiment" and had the developer incorporate our file manager into the project to eliminate some of the programming. The programming was "finished" over the course of the next year.

The system *was* useful for the office involved. Office personnel were able to more effectively manage the activities that the system was designed to handle even though there were numerous times when programs had bugs that created small crises. The developer soon moved to another office and did not want to continue to maintain the system, and the documentation was non-existent. This resulted in about nine months of difficulty as computer center personnel managed the small crises that resulted. Finally, we spent an entire summer rewriting, and documenting the system, to enable it to be maintained for the future. The resulting system has now worked without a failure for the last 15 months, and continues to serve the needs of the office. The main problem with the current system is that we do not have the time or expertise to modify the system to incorporate new features desired by the office.

Lessons learned

Many lessons were learned over the last five years. We mention some of these briefly. Each of these has implications for the organization responsible for providing computer services.

1. **Avoid the "let the student worker do it" syndrome.** Administrative offices often use students to "do the work". This results in the development of student expertise but not expertise of the employees of the office. Using students in this way is often the easy way out, since many of them do not need extensive training. Of course this is short-sighted on the part of the office manager, and can lead to crises when the student worker returns to the role of student. This is often compounded by not providing the time for office staff to attend computer training courses. The result is that hidden liabilities are introduced into the office operations.

2. **It takes, on average, one disaster before even the most conscientious user will regularly back up data files.** Despite incorporating horror stories into each computer training course we find that even the most cautious of users requires a "personal experience" with losing data files before the concept of backup becomes internalized. A sign that has become popular on campus states "Blessed are the pessimists, for they have made backups". Backup must be continually emphasized and simplified. In addition, computer services personnel should develop experience with the use of "file recovery" utilities.

3. **Microcomputer support needs are underestimated, sometimes dramatically**. Some notable examples include the time it takes to update 35 copies of a word processing package to the latest release; the time it takes to teach users the new features of the upgraded package, and the time spent with the users who cannot attend the training sessions. Standardization does not eliminate the need for support it only makes it manageable. The obvious implication is that staffing needs will be greater than anticipated.

4. **Users' perspective on time changes as they become proficient.** Users forget how long it took to find something that was in a folder in a filing cabinet. They are impatient if it takes more than 30 seconds to locate the same information in a data base containing several thousand records. Remember how long it took to get all the materials together for something you were typing? Now users are impatient if it takes more than 10 seconds to load the document that they were working on when they last left the machine. This will be a factor driving people to faster machines and disk technology. Awareness of this phenomenon is important to help users make sensible hardware choices.

5. **The availability of support services encourages standardization.** This is a variant of the "carrot - stick principle". Most, but not all, users will see the value in using a system that is being used widely on campus. This is the most important reason that standardization simplifies support needs. It should be pointed out that standardization can be more expensive. For example, the standard package may be more expensive than others that do basically the same task. In spite of this, users are usually willing to make the trade off of the cost of a product for the availability of support. The computer services organization must continually emphasize the value of support.

6. **Users must become more independent if support costs are to be managable**. Inherent in distributing the computing power through the use of micros is the need for office personnel to become knowledgable users. As Phyllis Sholtys has said in discussing the role of the office micro user, "There is, however, increased responsibility that accompanies such

increased freedom and flexibility".[3] This does not mean office personnel must become computer experts, but rather intelligent managers of their office computer environment. Users learn much from each other, and they must learn to accept a greater degree of responsibility for their computing than would be the case in a centralized computing environment. The computer services organization must remind itself that they should teach users how to do things for themselves rather than doing things for them.

7. **Printers will be a major source of problems**. Despite a reasonable level of standardization the most technical part of using a software package is understanding how to make the printer do what it should. Hardware reliability is necessary but not sufficient to avoid problems. A large portion of user problems result from not understanding how the printer can be controlled within a software application.

   A mundane but important point that is often overlooked in planning for the office workstation is that sound enclosures are needed for all but the most casually used (or expensive - laser) printers. Failure to recognize this results in a disruption of office operations.

8. **Users will be creative and inefficient**. Computer professionals and naive users don't use computers in the same way. It is common for a user to discover a way "that works" and to continue to use that method even if that is not the "best" way to accomplish that task. An example is the confusion between the use of spreadsheets and file managers. The similarity between the use these two applications for keeping track of information often means that users make the wrong choice, using the software with which they are familiar, rather than the one best suited to the task.

   It is incorrect to assume that because users don't ask questions that they understand what they are doing. A valuable support technique is "support by walking around" to offices and watching what people are doing. It is important in this regard to avoid teaching novice users short-cuts, the use of these "time-savers" invariably will result in an increase in support questions.

9. **Training is a continual support need**. Even with standardization of the workstation environment changes in personnel, upgrades to hardware and software, and the availability of new capabilities necessitates a long term approach to providing computer support. Despite the distributed nature of the equipment, the need for a strong centralized support organization, one that can coordinate training and other support functions is essential. While knowledgable users become an extension of centralized support, their jobs do not depend upon providing computer services. There must be an organization whose responsibility is to coordinate both the centralized and decentralized administrative computer services. A variety of training methods should be available (e.g., audio tapes, short courses, weekly meetings, hands-on seminars).

10. **Office managers should take a leadership role in implementing technology in administrative offices**. The office manager must understand how the technology is being used, its limitations, the training needs, and the possible benefits and risks of the applications being used. Without the involvement of the office head the potential benefits of the technology will not be fully realized.

    In our experience, it has been all too common for the office manager to be a non-user of computer technology. In such cases the office personnel fail to utilize the equipment in the most effective manner to meet the office's information needs. Worse yet, important decisions about the information management needs of the office may be delegated, de-facto, to clerical personnel.

11. **Legal and ethical use of software must be encouraged.** Software copyright laws are not easy to understand, and much incorrect information exists about what is permissible. We have had to continually remind office personnel of their obligations with respect to the proper use of the software that the College has licensed. In this regard it is important that policies for software use be developed campus-wide. We have adopted a policy on software use and have distributed the brochure "Using Software"[4] to all employees of the College. The computer services organization must encourage users to act responsibly.

Recommendations and Conclusions

In order to implement some of the above strategies it is necessary that high level administrative support be evident for them. This requires that a procedure be in place so that requests for microcomputer equipment can be reviewed for consistency with institutional strategies. It must be recognized that this approach will often appear to be more costly, and bureaucratic, but in fact will be more economical when personnel and training costs are considered.

It is inevitable that microcomputers will find their way into administrative offices by the nature of their use in support of the teaching and research needs of the college community. What is important is the way in which their use is managed by those responsible for providing administrative computing services. The application of microcomputer technology in such offices has many potential benefits, and associated dangers. By following some simple strategies many of the benefits can be realized while minimizing risks to the integrity of institutional information resources.

References:

1. David L. Smallen, "Computing at the Small College - The Computer Services Perspective", EDUCOM Bulletin, Fall 1987, p.8.

2. Douglas Van Houweling, In conversation, 1976.

3. Phyllis Sholtys, "Issues Surrounding The Use Of Micros In A Mainframe Environment", Cause/Effect, November 1987, p. 32.

4. Using Software, EDUCOM and ADAPSO, 1987.

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MURPHY'S 1ST LAW AND ITS APPLICATION TO ADMINISTRATIVE COMPUTING

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Murphy's 1st law is well known. Its application during the administrative computing conversions at Wittenberg University from DEC/ Quodata/ QDMS/ Archon systems to PRIME/ DATATEL/ INFORMATION/ Colleague systems is chronicled for the unsuspecting and unknowledgeable.

This particular form of Murphy's 1st law is the Gestalt form; i.e. when anything can go wrong in an integrated environment, it will do so exponentially.

CAUSE members should not be surprised to learn that Murphy's 1st Law was well demonstrated at Wittenberg. Its pervasiveness is documented in this paper.

I. INTRODUCTION (Murphy's 1st Law, Corollary I - You will be lulled into a sense of complacency prior to utter chaos.

In the early to mid 1980's, Wittenberg University operated its administrative computing functions in what we believe was an extremely effective fashion. Effective because all administrative systems were fully integrated under a common linked-file data management system, QDMS from Quodata Corporation. All administrative functions were computerized under QDMS; 70% were in-house systems and 30% were purchased. The database permitted production of ad-hoc reports within systems and linked ad-hoc reports across systems without any programming whatsoever. These reports could be formatted automatically or precisely formatted with a user defined page layout. A full-time administrative computing staff of three including one operator/programmer served a user community of 2,346 (2,214 FTE) students, 141 faculty, and 300 clerical and professional staff.

As we learned to use the QDMS resources effectively, we also became constrained due to our Digital Equipment Corporation (DEC) PDP 11/70 memory, architecture, and performance limitations. Within the limits of our hardware and software, we felt we were on the cutting edge. When we reached the point where we could not make or expect significant improvements, we conveyed our concern to the Executive Committee and President and projected replacement of the hardware and software in a progression of 5-year plans. Although funds were not available, we tried to stay abreast of the marketplace just in case.

In the fall of 1985, a series of highly unusual events occurred. First a substantial unrestricted bequest was received by the University. Second, several major offices including Admissions and Advancement had encountered the limitations of our QDMS/PDP 11/70 software/hardware combination and were actively pressing for replacement. Third, and perhaps most importantly, our President was prepared to support funding administrative computing within his round-robin method of dealing with major University capital funds needs.

The preceding optimal circumstances were not known to the Center staff in October 1985. We were "lulled into a sense of complacency and well being."

II. SELECTION PROCESS (Murphy's 1st Law, Corollary II - The better prepared you believe you are, the more likely the resulting chaos.)

A. Driving Criteria and Considerations

In October 1985 with no preamble, the Center was requested to prepare a plan for selecting new administrative computing software and hardware. On November 1, 1985, we suggested five options and a five month assessment period. The five alternatives were:

1. Britton Lee/DEC
2. Information Associates/DEC
3. Datatel/PRIME
4. CARS Information Systems Corporation/DEC
5. Quodata Corporation/DEC

These five alternatives were analyzed by Center staff on the basis of the following four criteria.

C-1. The procurement would be software driven, rather than hardware driven.

C-2. The software was required to be based on a relational or a "near-relational" type of data-base that had a sufficiently flexible report writer to permit end users to produce creative linked reports without assistance of Center staff.

C-3. The software was required to possess a full spectrum of administrative computing applications so that development of in-house applications could be minimized or eliminated.

C-4. The thrust of the application software was required to support decentralized computing with user offices controlling their own destinies as much as possible.

Within one week of our initial proposal, we were requested to narrow the five alternatives to two and cut the evaluation period to two months.

B. Evaluation Process/Departmental Involvement

In addition to the evaluation criteria by the Center staff, statements of needs were developed at University-wide and departmental levels. These needs were used as final evaluation criteria. The final two vendors were then requested to make extensive on-campus presentations to the user departments of the University. The vendor documentation, vendor demonstrations, and information learned from existing vendor customers were used for the final analysis and selection. It had been hoped to make one week visits to existing user sites of the final alternatives but time and circumstances did not permit.

Dr. William Kinnison, Wittenberg's President, was astute in requiring executive level approval of the final decision. While the Center staff assisted in the initial culling, the final choice was made by the users through their representation on the Executive Committee. Hence, the "ownership" of the hardware and software resides with the user departments, not the Center. This was a fundamental departure from previous procurements of the University and fully in step with evaluation criteria C-4 dealing with decentralized computing.

C. Resulting Selection

The final decision was delayed until March 1986. Suffice it to say that a comprehensive contract was signed with Datatel Corporation for both the software and hardware. It is beyond the scope of this paper to discuss the analysis leading to our decision.

The whole evaluation and selection process was chaotic in spite of the continual assessment and study over the years that had preceded the procurement. Hence, Corollary II of Murphy's 1st Law, "The better prepared you are, the more likely the resulting chaos."

III. TRANSITION CONSIDERATIONS (Murphy's 1st Law, Corollary III - It will always be worse than anticipated.)

A. Special Problems in Converting from One Fully-Integrated System to Another Fully-Integrated System

We believe that Wittenberg's conversion efforts are unique in that the University already was using fully-integrated systems linked together by Quodata's QDMS software. This high level of integration has made the transition to Datatel's fully-integrated systems very difficult. Initially, we considered cutting over the whole University with a week's time, essentially shutting down during that period. However, we determined that we didn't have sufficient support staff. Since we had to go piecemeal, work-arounds on both the QDMS and Datatel systems were developed to simulate the integration. The ordering and timing of conversions likewise has been very critical.

B. Physical Connection of Terminals and Devices - Local Area Network

During conversion, users needed to have terminal and microcomputer access to both the DEC PDP 11/70 and PRIME 9955 Model II computers. This problem was resolved by extending the University's VAX-based XYPLEX local area network to both computers. Consequently, users can issue "connect" commands to whichever computer is appropriate during the conversion process.

C. Scheduling (Initial)

Development of the initial schedule for training, conversion and network installation was carried out in consultation with Datatel staff and projected an 18 month period. This schedule was developed as a best guess three months before the hardware ever arrived. Within a few months of hardware/software installation, Center staff realized that at least 2 1/2 years efforts would be required. Meanwhile the Executive Committee was pressuring to reduce the schedule to 12 months. The 250% difference in expectations was potentially disastrous. More will be said later in Section IV.

Hence, the statement of Murphy's 1st Law, Corollary III "It will always be worse than anticipated" is appropriate.

IV. AGONY OR "THE NITTY-GRITTY UNEXPECTED PROBLEMS" (Murphy's 1st Law, Corollary IV - When things seem to be at their worst, they're not, or it's always darkest before it's pitch black.)

A. DEC to PRIME Transition Problems

The PRIME 9955 II computer hardware was installed in mid-June 1986, one month later than anticipated. Datatel Software was subsequently installed in mid-July 1986. Initially, we experienced a number of problems due to a lack of familiarity with PRIME hardware and the PRIMOS operating system. We had been assured by PRIME and Datatel that there would be "no problem" with providing DEC VT-100 terminal capability which was critical because most of our video terminals were DEC VT-100 compatible. While the implementation of VT-100 capability is straightforward in principle, we were one of the first Colleague user institutions to migrate from DEC to PRIME and one of the first institutions to install DEC VT-100 driver interfaces.

A second problem was incompatibility of DEC and PRIME tape utilities. We ended up using custom programs to avoid difficulties.

A third major factor when changing hardware vendors is the loss of staff expertise and the time required to bring existing staff back to expertise levels held on former hardware.

B. PRIME INFORMATION Considerations

The PRIME INFORMATION database which underlies Datatel's software is absolutely superb. However, the database lacks a major feature which has made conversion much more difficult for us: the lack of a formatted or page style report writer. (This should not be confused with the single line per transaction type report writer which is present and is excellent!) Currently custom programming is required to produce paragraph or page type reports (e.g. class rosters, phonathon cards, student invoices). While the technique is relatively straight forward for programmers, it is beyond the capabilities of end users. Since two of the objectives of our procurement were to minimize program maintenance and to place a powerful ad-hoc paragraph-style report writer directly in the hands of our end users, we have been very disappointed.

Offsetting this disappointment was the "Pick" type power of PRIME INFORMATION. We now had variable length fields, multiple-valued fields, and unlimited-length records with the capability of storing lengthy comments.

C. Conversion Calendar Catastrophe

The other problems contributing to conversion were:

1. The lack of a common definition of "conversion" between Wittenberg and Datatel. Datatel's definition was essentially a simple translation of previous data, training on the new software, and cutover. Wittenberg's understanding was different - Wittenberg had the need to reproduce existing functionality without major concern for esthetics. This meant possibly adding bells and whistles to the product if the bell was already being rung by an end-user.

2. Scheduling underestimates. Wittenberg had only one other conversion in its administrative computing history. When Datatel originally suggested 12 to 18 months as being sufficient, we were not in a position to contradict.

3. Staffing Level Problems. Two types of staffing problems occurred. The first was failure of the University to provide a temporary programmer as proposed from the inception of the project. The second problem was the unsuccessful attempt to directly involve all Center staff in the conversion effort. For reasons of better morale, our initial conversion efforts had involved all Center staff. Unfortunately, we could not find adequate time to dedicate to conversion in this mode while continuing to maintain the old systems.

4. Inexperience. Conversion is a unique experience. Since conversion is likely to occur only once every five to ten years, conversion was completely new to most of our staff.

5. Inability to Identify Similar Conversion Efforts. We made very conscientious efforts to contact a sizeable number of institutions about potential problems that might occur during implementation and conversion. Because of our existing level of development, the information gleaned from representatives from most other institutions did not reveal the scope of the necessary conversion efforts.

By December 1986, we had reached the state that we ascribe to Murphy's 1st Law, Corollary IV. "When things seem at their worst, they're not or it's always darkest before it's pitch black."

V. PRACTICAL SOLUTIONS. (Murphy's 1st Law, Corollary V - The more work you do, the more there is to be done.)

A. Picking Up the Pieces

By Fall 1986, Center staff realized that an 18 month conversion schedule was impossible. The Provost was apprised of the situation and informed that a three-year schedule was appropriate to complete a high quality job.

Because of legitimate doubts, the Provost sought and received high level consultation with Datatel to recommend a new schedule and to identify additional resources necessary to successfully complete the conversion. This move was astute and ultimately gave credence to the Center's estimate of a three-year schedule. Besides seeking assistance from Datatel to help develop the revised schedule itself, the University contracted with Datatel for extended services support to provide management assistance, on-site training, and off-site programming support during conversion.

As part of the solution, major changes were made in Center staffing patterns. First, the conversion efforts were almost completely separated from the maintenance efforts. We hired one temporary programmer and reassigned a staff member from systems/network activities to the administrative conversion team. Our staff of three grew to five. Three people were assigned full time to conversion and two people to supporting the existing systems.

The Executive Committee of the University decreed that enhancements by Wittenberg Center staff beyond the functionality already present in the QDMS systems would not be attempted as part of conversion. This lowering of internal expectations in user offices has been a critical factor in the successful maintenance of the new three-year schedule.

Once all of these arrangements were made and implemented, the conversion tasks became possible, albeit extremely demanding and exhausting.

A typical pattern has evolved in all of our conversion efforts:

1. Users are provided with initial documentation about their new system and given access to a trial version of their new software.

2. Center staff study and investigate software, trying to identify relationships between old and new files and fields.

3. Initial training is carried out by Datatel staff at Wittenberg for Center staff and users.

4. Soon thereafter a Datatel representative and Wittenberg staff map old fields and files to Datatel fields and files.

5. Final mapping specifications are sent to Datatel for programming.

6. Users continue to investigate systems and enter code file information in the trial account.

7. After initial version of the conversion program is received from Datatel, Wittenberg staff make corrections

and modifications. Data integrity is carefully checked by Wittenberg staff.

8. Functions and reports not supplied by the "canned" software are put in place.

9. Full conversion is carried out in the test area first. Back and forward links between old and new systems are developed.

10. Conversion is carried out and cutover is made.

11. Cutover problems are resolved. (So far such problems have been minimal and satisfaction high.)

B. Successes!

Full conversions have been completed for Advancement and the Business Office (General Ledger, Accounts Payable and Accounts Receivable). In addition, the Cashier's Office and Purchasing Office have been brought on-line.

C. Future Conversions and Schedule

By the first of the year, we will be live with Payroll and Personnel. Admissions and Financial Aid will be cut/over by the end of January 1988.

Currently, we are planning conversion of Registrars systems in the spring. All basic systems will be completed by July 1988. The last year of our efforts will be dedicated to secondary applications already developed on the old system; e.g. Career Development, Car Registration and Inventory.

It becomes clear that Murphy's 1st Law, Corollary 5 holds: the more we do the more we have to do.

VI. CONCLUSIONS (Murphy's 1st Law Continues but it's still possible to laugh.)

We have proceeded from euphoria (the selection and purchase of new software) to despair (realization that our calendar was unrealistic and staff support inadequate) to cautious optimism concurrent with continual exhaustion. We are confident that we are proceeding in a realistic and attainable schedule so long as our health and morale can be maintained.

We have general advice for other institutions considering switching to new state-of-the-art software and hardware.

Do not underestimate the length of time required for conversion or the additional staff required during the conversion process. One suggestion is to byte the bullet by hiring an external consulting firm to estimate the scope of the conversion tasks, the length of time required, and the staff and financial resources required. We did not do this and made a tactical mistake in not so doing. The analysis permits uniform and realistic expectations to be formed by everyone from data-entry clerks to the president. We could have avoided all the "prophet in one's country" syndrome.

We also recommend that an institution separate its staff resources into a sub-staff responsible for maintaining existing systems and sub-staff responsible for converting/implementing the new system. Existing staff will not be enough. We can assert that temporary staff must be employed.

There are a number of excellent and continually improving packages available. No canned system can supply all of the functionality to satisfy an institution which aspires to excellence and wants to stay at the cutting edge. Therefore, when shopping for administrative software, you've only done half the job when you determine that a vendor's software functionality meets your basic needs. The power of the data base underlying the vendor's products must be examined just as closely. If maintenance of the administrative systems is with an outside vendor and powerful tools are available within the data base, then it only requires a small energetic creative staff to take any college or university to the forefront.

Finally, we want to make a public statement in support of both Quodata Corporation and Datatel, Inc. as vendors of high quality administrative computing software. Our decision to switch to Datatel was complex but based heavily on the lack of available developed QDMS administrative applications on VAX systems at the time of our procurement. Quodata Corporation has very competitive systems and should be seriously considered as a vendor. The Datatel packages that have been converted are working well with performance more than meeting our expectations. The ease of use of the PRIME INFORMATION query language INFORM has been an absolute joy for our end users. In our estimation, the Pick operating system of which PRIME INFORMATION is a variant is one of the most powerful and elegant data bases in existence. It has to be experienced to be appreciated.

We still have much work ahead for the next 12 to 18 months. We still have difficulties but much of the pain is behind us. Throughout the process, we have managed to keep our sanity by laughing at ourselves. In spite of Murphy's 1st Law, we still survive!

LEVERAGING RELATIONAL TECHNOLOGY
THROUGH
INDUSTRY PARTNERSHIPS

PREPARED FOR
THE 1987 CAUSE NATIONAL CONFERENCE

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Abstract

Many higher education institutions as well as software vendors who provide applications software to institutions have attempted to move gradually from conventional file structures and access methods to the technology of data base management system. There have been and are significant impediments to this transition. For the institution a double barreled drawback exists of massive conversion and a staff who for the most part are untrained in and inexperienced with the DBMS technology. The software vendor seems further impeded by the realities of the third generation marketplace. Carnegie Mellon University has chosen to leverage its significant technological expertise with DBMS (particuarly relational) into joint technological and developmental partnerships with a few DBMS and application software vendors. These partnerships have and will result in a base of knowledge in support of the transition to relational data base technology.

DECEMBER 3, 1987

LEVERAGING RELATIONAL TECHNOLOGY THROUGH INDUSTRY PARTNERSHIPS

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THE CARNEGIE MELLON ENVIRONMENT

Computing Intensive

Carnegie Mellon University located in Pittsburgh, Pennsylvania is the home of a College of Fine Arts, a College of Humanities and Social Sciences, the Mellon College of Science, the Carnegie Institute of Technology, a School of Urban and Public Affairs and the Graduate School of Industrial Administration. It not only offers a computer intensive environment to its 6500 students, 400 faculty and 1900 staff but also serves as an intellectual resource for the 1.1 million residents of the Greater Pittsburgh area.

Carnegie Mellon is also home of nearly 4000 University owned computers. These include one IBM 3083, more than 100 IBM PC-RTS, in excess of 2000 IBM AT, XT, and PC class computers; slightly under 100 DEC VAX 8650, 8700, 8800, 11-780, and 11-750 machines; 5-10 DEC 2060s, more than 500 Microvaxes, approximately 200 Sun II and III workstations and in excess of 100 Apple Macintoshes, MAC-SE's and II's. In addition to university owned computers, more than thirty percent (30%) of the student body own their own computers and over forty percent (40%) of the faculty own their own computers. 300-400 computer professionals are employed on campus, many of whom directly support various academic and administrative functions.

Intellectually Inspired

Speaking to new faculty in August of 1987, Dr. Herbert Simon, University Professor of Psychology and Nobel laureate provided an intellectual perspective of Carnegie Mellon when he told the faculty about the computer intensive environment. He said:

"You are all aware that CMU is pioneering in the domain of networked communication as a tool of education. There is an important distinction to be kept in mind here. We do not think of CMU as a computerized campus - though you will see many computers here. I want you simply to understand that the computer network has been built here as an experiment, an experiment in education in which we are all participating. Neither the Administration, nor the Faculty nor the proponents or designers of the system have more than a hazy idea of what its role will be ten years from now at CMU (if we haven't meanwhile torn it out). And its role will be exactly what you make it, or choose not to make it, through your ideas of how it can enhance your teaching and your research. It is an invitation to be innovative."

Carnegie Mellon's innovative and creative spirit permeates many areas of the University. It is this spirit of innovation coupled with the opportunity to experiment with new ways of thinking about solutions to problems that has given rise to the notion of technology partnerships in administrative computing and information systems. The idea is also born from a need. The need exists to provide better information to meet the ever present demands of a changing enterprise. As Dr. Simon so aptly pointed out, "Carnegie Mellon will change in ways not yet imagined." Colleges and universities should use information and the software that drives the production of information as strategic tools of the enterprise with the flexibility to be moved from one operating system environment to another. The portability of software permits the University to take advantage of opportunities offered by the changing technologies. In a Carnegie Mellon University report dated September, 1987 the commission to evaluate the President cited **Information** as one of four primary resources that the President must gather and allocate. Further, the Commission suggested that as an administrator, "the President must govern managerial information."

Administrative Information Systems Environment

The university President and others who govern and administer Carnegie Mellon recognize the importance of flexible and powerful information systems which will enhance administrative processes and provide information as a resource to a broad base of constituents. Executives, administrators, deans, department heads, middle managers, staff and faculty are among the traditional consumers of information to which will now be added students, parents and guardians, corporations, foundations and alumni as well as governmental and legislative bodies.

The recognition of (information) need across a broad spectrum of constituents has led CMU to explore joint efforts with a few commercial firms so as to: (1) develop software which will provide needed information, support new strategic functions and enhance existing administrative functions and (2) multiply the effect of the University's available resources.

Administrative System applications can be found running in somewhat peaceful coexistence on two DEC 2060's; a DEC VAX 8700; three VAX11-780's; an IBM 3083 EX, a 3Com Based, PC Ethernet LAN; several Appletalk networks as well as stand alone personal computers. The current direction is to migrate strategic administrative applications from the IBM 3083 and the DEC 2060's to an integrated, relational database environment operating on a cluster of two DEC VAX 8700's (running VMS) December 1989.

The strategic intent is to utilize state of the art relational data base technology and create advanced systems functionality. For the next few years the administrative information system services, support and development at CMU will be centrally planned, managed and implemented Planning and oversight of implementation by non-central departments will improve the probability success. Recent efforts to design and develop a university information system (UIS) data base and to define the functions and features of student and human resource information systems have provided a model for collective participation, planning and oversight by many university constituents.

The result of the next implementation of administrative information systems will not only provide for distribution of processing and computing, but also provide a basis for distributed data bases. While some enterprises and only a few Universities moved to data base applications in the late 60's and early to mid-70's, Carnegie Mellon developed applications where programs and data were inextricably intertwined, file and data structures were relatively straightforward. We initially were concerned about relational data bases used in intense transaction-oriented applications. The rapidly decreasing price-performance ratio of processors channels and disk storage, however, caused this relative inefficiency to be less of a concern to the CMU information systems planners. Further, the portability of application code and the development productivity are key strategic issues we were unable to overlook.

THE STRATEGY OF PARTNERSHIPS

During Spring 1986 CMU, IBM, DEC and Relational Technology Inc. (RTI) conducted extensive benchmarks of the RTI relational DBMS; the results were extremely favorable. Transaction volumes and response times were measured over a two week period at DEC and IBM data centers. Because of the level of support from DEC and IBM the "benchmarks" really launched the partnership era between the CMU Administrative Systems office and major hardware, database and application software firms.

Following the IBM, DEC and RTI benchmark initiative, CMU felt that some commercial applications software firms would be interested in establishing academic/business relationships and partnerships related to relational data base implementations. Commercially available software was reviewed carefully and these decisions evolved:

- CMU would not attempt to purchase software at full market price but rather would negotiate relationships based on joint participation and resource sharing.
- Opportunities would be explored for joint development, enhancement and/or conversion of vendor-supplied software.
- (Commercially available) software packages which could not be acquired without major out-of-pocket expenditures or which were functionally or technologically inadequate would not be purchased but rather would be designed and developed by CMU staff or jointly with vendor personnel.

The availability of relational data base technology, fourth generation languages, programmer productivity tools and a rich VMS and UNIX development environment at CMU had already proven to greatly expedite the development process. CMU began the process of functional and technological review of existing (commercially available) software. Concurrently, discussions were held with commercial software firms regarding future product directions and interest in the higher education administrative information systems market. Discussions were not confined to firms already servicing the market; new partners were sought and considered. A key part of the strategy was to identify niches where competition was not so stiff nor the market so crowded as to nullify the interest of firms in the market.

Prior to 1986, vendors (except for CARS of Cincinnati, Ohio) of software in the higher education marketplace had revealed no applications based on relational data bases. SCT has since introduced a new product which uses ORACLE as its data base system. The higher education administrative systems software market appeared to be dominated by DEC interactive systems and

IBM (hardware and) batch oriented (operating) systems. The primary market interest in the relational model appeared to be oriented toward IBM's relational products-DB2 and SQL/DS and DEC's RDB. In the DEC world, INGRES and ORACLE were beginning to compete heavily with RDB; ORACLE was emerging as a key "relational" player in the IBM marketplace, and for that reason ORACLE was beginning to enjoy familiarity among higher education administrative systems practitioners.

The advantages of such partnerships, we believed, were related directly to the perceived market value of the future products. CMU continued to seek out commercial (software and hardware) partners so as to leverage CMU's technological advantage and perhaps persuade other industry partners to participate in the development of new systems.

Further opportunities may exist for partnerships. Continued evaluation and support of relational data base and distributed data base technologies and investigation of lower cost (parallel) processors as a means of improving relational data base performance at substantial reductions in price performance ratios is also of interest. Discussions with processor firms have resulted in near term opportunities for moving current relational products to parallel processors.

THE RELATIONAL DATA BASE STRATEGY

Why Relational?

With data being stored as a collection of tables in the relational data base, users (programmers or end-users) can combine data elements from different tables to new tables or relations allowing access to relationally stored data. Unlike the hierarchical or network storage organization, the relational model requires little or no knowledge of the structure of the data base. The fourth generation languages when integrated with productivity tools work to facilitate rapid applications development by both "relational" data base programmers and end-users. As in the case of the CMU UIS (University Information System), once the data base was designed the screens and reports were developed expeditiously. The development productivity ratio over conventional PL/1, Fortran and Cobol coding are expected conservatively to exceed 2 to 1 in favor of the relational /SQL applications.

A second major factor in the selection of the relational data base was the portability to a broad base of micro, mini and main frame environments (hardware and software). The value of portability cannot be overstated. This attribute ensures that applications developed on the PC running MS-DOS or the VAX running VMS or ULTRIX or the IBM 3083 running VM/CMS or on the advanced workstation running UNIX will not have to be rewritten to run in these other environments. For the first time applications will not be constrained when (if) different hardware or operating systems environment is dictated. The proof of portability is in the accomplishment: CMU is currently moving two major data base applications from VM/CMS INGRES to VMS INGRES The movement will be complete by February, 1988. The results so far are rewarding.

WHY SQL?

In most organizations, there is increasing desire to standardize on a query language for accessing data. With the design of the relational database structure, SQL was built to enhance access to that structure. In addition to providing a consistent set of semantics for the user, it also was seen as a way to provide inter-database communication between various database software vendors. IBM has finally endorsed SQL as the "official" query language standard for relational database systems. In 1982, the American National Standards Institute chartered the "database committee" to develop a proposal for a standard relational language. This committee, with representation from various (dbms) vendors, are refining the actual "standard". Although not yet in its final form, SQL plays a major role in providing the necessary query tools for clients within the campus to build ad-hoc retrievals against the database.

SQL has been modeled to work well within the relational database structure. Unlike other query languages, it builds upon the same syntactic constructs to build complex queries as well as subsets of data; it is possible to "nest" retrievals for more defined output. Application developers can move from one environment to another without the need for expensive retraining. Applications will become more portable, especially those developed by third party software vendors and can run unchanged in a variety of different hardware and software environments. Since the query language is a standard, it is assured of a reasonably long lifetime.

As data within more organizations are spread across various machine types, it becomes increasingly more important to provide data sharing across those different databases. This task is much simpler if the product (from the same vendor) operates across the heterogeneous systems. In the event of different database vendors, this function has been impossible. Recently however, there is a standard for inter-dbms communication which exists around the SQL standard. Soon, we hope, applications built with tools from one vendor will to talk to other vendor's databases with minimal rewrite and interfacing.

WHO CHOSE CMU? WHO DID CMU CHOOSE?

Relational Data Base Firms

Why INGRES?

With evaluation of various database products on the market, the range of possibilities were narrowed to a few in terms of functionality and operating environments. The requirements were for: (1) A wide suite of development tools would exist within the product (2) a product that operated across MS-DOS UNIX 4.2, VMS, and VM/CMS (3) data and program portability across those systems and (4) a demonstrated commitment to excellence within the product, in terms of regular improvements in function and performance.

The CMU Administrative Systems office chose INGRES as the platform upon which to develop a new suite of administrative information systems for all of the reasons cited above. The development environment possessed robust 4GL capabilities and programming language interfaces (COBOL, C, PASCAL, ADA). INGRES contains an object-oriented approach to all of the internal data dictionary elements which operated reliably, as applications were moved across operating systems. It also provides end user decision support tools. Internally, some development had been done with specific applications based on INGRES and over the past two years with those applications the performance increased 50% with each new release. INGRES provides the ability to separate the applications from the data structures. With various index structures supported, it was possible to tune indices to match the need of the application. Noticeable improvements in performance have been demonstrated.

We feel that distributed database management may be a key to the integration of different computers and operating systems. Distributed database products should simplify data management through software that (automatically) tracks information within a network, allowing universal access to the information, and transferring control of local information to local machines. Distributed database management should impact costs through incremental growth of computing resources. The investment in existing resources can thereby be preserved. We anticipate that the ability to increase transaction rates will occur by spreading tasks among several network nodes. INGRES/STAR for example, is an open architecture design that allows extension to support multiple vendors' hardware, software and networks. INGRES was designed from its inception to support distributed database technology. This initial design approach allowed RTI to install their distributed database product somewhat in advance of the market. INGRES/STAR has separated front-end applications process from the back-end database management software. In this type of architecture, the application asks for data using the SQL database language. This architecture allows addition of a distributed database manager between the front-end application and several back-end databases. INGRES/STAR supports a distributed database manager which allows local INGRES DBMSs to operate autonomously and provides an architectural framework to permit easy access to non-INGRES databases.

Since INGRES is ANSI SQL-based and provides data base gateways to DB2, RMS and other non-relational data base systems, (INGRES) does provide the opportunity for development of industry standard data base systems and applications. The SQL compatibility and the INGRES suite of development and end-user tools provided the incentive for a few vendors to seriously consider joint efforts with CMU.

Relational Technology identified the CMU Administrative Systems office as an organization which could play a key role in the beta-testing and planning effort of the product. An example of this was in the beta-testing performed of their VM/CMS version. CMU provided input as to problems and enhancements needed in the product. This input was received by the developers and quick resolution of problems ensued. RTI's approach to applying engineering changes in this new version, back into the other versions of the product, demonstrated their commitment to excellence in the product.

Furthermore, with the number of heterogeneous operating systems existing in a single geographic location, CMU is an ideal location for stress testing new technology, such as distributed database systems. The campus community was identified by RTI as one in which people sought new technology to provide better solutions to existing problems. RTI and CMU subsequently signed a five year technological partnership for administrative use of INGRES across all systems.

The Application Firms

Student Information Systems

The University selected five vendors of student information systems (SIS) for functional evaluation. Each vendor was asked to present a demonstration of the available software and/or assess the fit against the documented requirements. In all cases, demonstration and discussion (or both) were undertaken to describe the important functional aspects of the package. In addition, the tuition/billing aspects of the vendors' student accounts receivable systems were investigated when those functions were not included in the basic student records software. In technical evaluation, the "as-delivered" version of each vendor's package was considered, as well as the possible modes of conversion of the software for greater functionality in the CMU environment. The SIS vendors selected were: (1) Campus Administrative Resource Systems, Inc. (CARS) (2) EduCon Associates, Inc. (3) Information Associates, Inc. (4) Systems and Computer Technology, Inc., (5) Sigma Systems, Inc.

There was no obvious match for the selection of a student record system (SRS). In each case, there is a significant level of cost and risk associated with each feasible implementation strategy. For example, the RMS/COBOL systems would install easily in the VAX/VMS operating system, but lack the useful features found in relational database systems. In other cases, available relational systems would present serious obstacles to integration of data among the various student systems at CMU. No vendor was including decentralized functionality as specified in the CMU requirements documentation for SIS.

Sigma Systems chose to supply the student aid system to CMU inasmuch as Sigma's goals seemed compatible with CMU goals. Design goals for the Sigma include a heterogeneous operating system environment, SQL-based file access, and maximal functional decentralization.

A partnership has evolved between CMU and Sigma Systems Inc. An agreement to enhance or jointly develop components of student systems is the cornerstone of the partnership. The Student Aid Management (SAM) System, was chosen as a starting point due to the pressing functional needs of CMU and the Sigma interest in a SQL. Some functional changes to SAM and SAR are required to meet the special needs of CMU. A recruiting admissions and enrollment management module will be tailored to the special CMU (enrollment management) needs. The resulting enrollment management module will be more complex than the current Sigma admissions system, ADAM. A registration and student records designed and developed with Carnegie Mellon's unique requirements in mind. A real-time design will result which addresses the CMU functional requirements and with the newly-developed CMU UIS data base design. **Figure 1** is a pictorial representation of an SQL query against the UIS database.

Human Resource Information Systems

A Human Resource Information System (HRIS) project was initiated in April 1986 to develop or install and implement new applications software to serve the multiple HR functions. Personnel and benefits administration, payroll, wage and salary administration, federal compliance, manpower planning, position control and budgeting and applicant tracking were among the modules being sought.

To define the requirements for the new HRIS: (1) a Campus Advisory Committee was created to provide input from the campus community, (2) a HRIS requirements definition document was jointly developed by a CMU Planning Task Force and Deloitte, Haskins and Sells and (3) survey questionnaire was administered to the campus a preliminary set of requirements formed a basis for requirement definition document.

The university plan was to implement the HRIS in the DEC VAX/VMS environment using INGRES. Selected vendors were contacted to assess their interest in a joint venture. This strategy we felt would permit the university to receive significant software license fee concessions in return for development work. The vendor would also provide consulting assistance as needed. Certain functional changes which would require changes to the source code would be incorporated into the vendor's package for marketing and enable CMU to participate in full vendor support including future upgrades.

The three vendors who expressed interest in a joint venture were: Cyborg Systems, Inc., of Chicago, Illinois, Integral Systems, Inc., Walnut Creek, California and Personnel Data Systems, of Philadelphia, Pennsylvania.

These vendors were asked to respond to the HRIS Requirements Document and then were invited to CMU for a presentation. The Planning Task Force prepared evaluations of the vendors and made a recommendation as to whether the university should purchase one of these systems for the new HRIS. Subsequently the planning task force selected CYBORG. The evaluation was conducted on technical and functional bases. The financial negotiations came later.

There were some concerns associated with the selection of Cyborg. The most problematic functional areas are multiple appointment processing and distributed processing with multiple approvals (i.e. "electronic signature"). In the case of multiple appointment processing, Cyborg wishes to include this functionality into a "University module ". Any necessary changes in source code will be made by the vendor. CYBORG and CMU will need to jointly research the problems associated with so called "electronic signature authorization".

The Tool Firms

In developing any new information system, a significant amount of time goes into designing the database as well as required functions. In order to expedite the documentation and design process, various Computer Aided Software Engineering (CASE) tools were evaluated. DEFT which was developed by the company DISUS, Inc. of Rexdale, Ontario, Canada was selected.

DEFT is a product that provides CASE tools not only for database design but also process diagramming and program documentation as well. An object oriented approach is used from system conceptualization to delivery. An added advantage is the interface that exists on top of INGRES by which Entity Relationship Diagrams are used to generate the actual relational database schemas. **Figure 2** is an example from the UIS application. This provides an excellent way to keep both database structures and documentation up to date with minimal redundant effort.

DISUS chose CMU as a partner based on the accelerated CMU systems development plan over the next few years and orientation toward decentralized systems. CMU was thought to be an ideal environment to have the product used as the vehicle by which designs and modifications are communicated across the campus. In addition, based upon our experiences, CMU will advise DISUS about enhancements or improvements needed in DEFT.

Hardware Firms

Discussions continue with hardware vendors where their future statement of direction includes areas of interest at CMU. Early discussions with manufacturers of parallel processing machines, for example, have resulted in the potential for joint development using relational data base systems to drive development of new applications.

Testing of relational data base designs for improvements in both CPU and I/O performance will be one goal. The second goal strikes to the heart of the issue of code portability from one operating system to another. The new parallel processors tend to be UNIX based; current CMU INGRES applications are either MS-DOS, VMS or VM/CMS. The second goal then will be to test the portability of the code to the UNIX operating system.

Other discussions have been held with a variety of hardware firms as new applications appear on the horizon. Some of these applications are discussed in **"FUTURE"** section of this paper. The key strategy here is to explore the best hardware and software solution to the needs of the application and not constrain our solutions by the strategic direction of one vendor.

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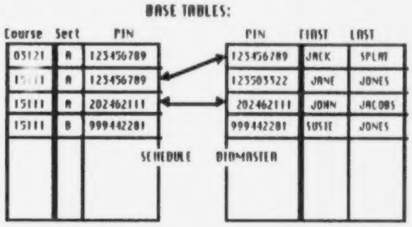
ENGLISH:

"Provide me with a list of students, their student id, first name, and last name, that are in the course: 15111, section A for the Fall 1987 semester."

INGRES SQL:

```
Select s.course, s.sect, b.pin, b.first_name, b.last_name from schedule s, biomaster b
   where s.course='15111' and s.sect='A ' and s.pin=b.pin and s.semester='F87'
```


BASE TABLES:
SCHEDULE
BIOMASTER

Course	Sect	PIN
03121	A	123456789
15111	A	123456789
15111	A	202462111
15111	B	999442281

PIN	FIRST	LAST
123456789	JACK	SPLAT
123503322	JANE	JONES
202462111	JOHN	JACOBS
999442281	SUSIE	JONES

Figure 1

UNIVERSITY INFORMATION SYSTEM
SQL Query To Extract Course Roster

RESULTS:

Course	Sect	PIN	FIRST	LAST
15111	A	123456789	JACK	SPLAT
15111	A	202462111	JOHN	JACOBS

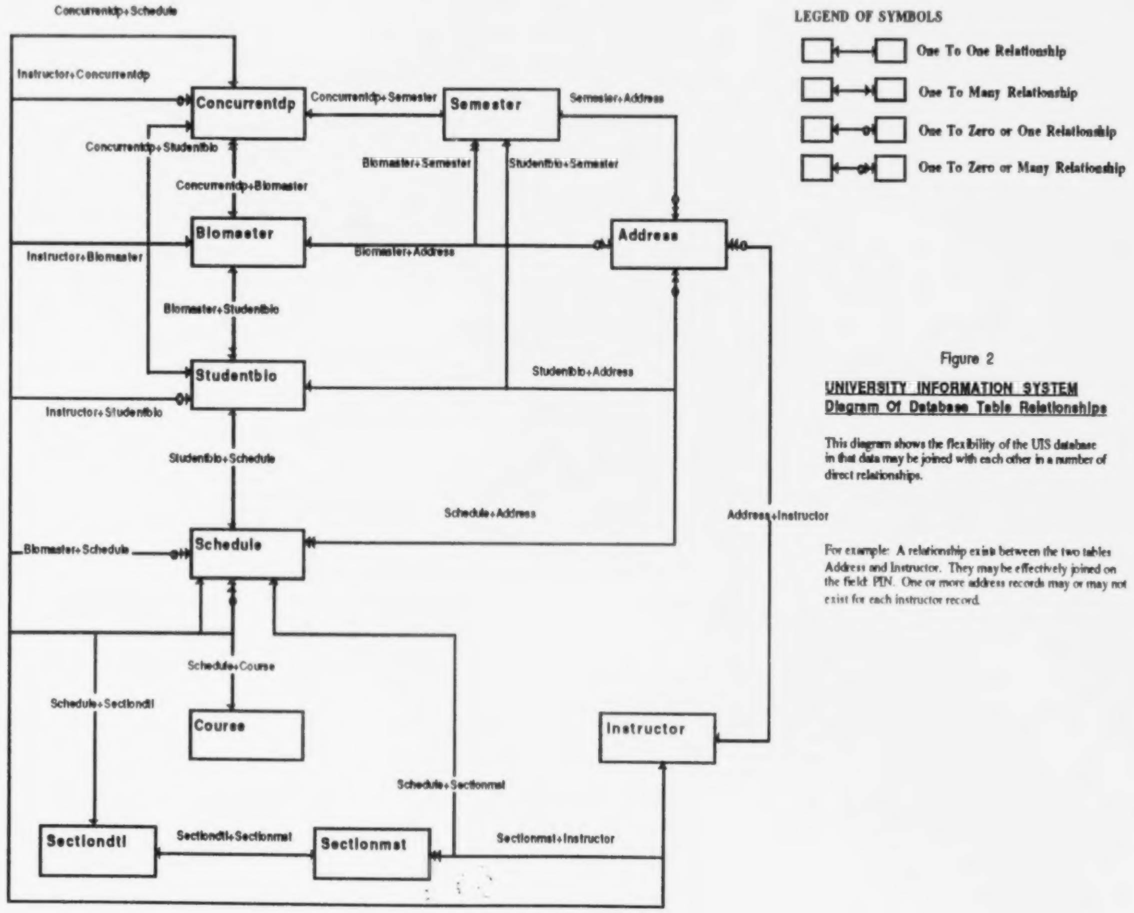

Concurrentdp+Schedule
Instructor+Concurrentdp
Concurrentdp
Concurrentdp+Semester
Semester
Semester+Address
Concurrentdp+Studentbio
Biomaster+Semester
Studentbio+Semester
Concurrentdp+Biomaster
Biomaster
Instructor+Biomaster
Biomaster+Address
Address
Biomaster+Studentbio
Studentbio
Studentbio+Address
Instructor+Studentbio
Studentbio+Schedule
Schedule+Address
Address+Instructor
Biomaster+Schedule
Schedule
Schedule+Course
Schedule+Sectiondtl
Course
Instructor
Schedule+Sectionmst
Sectiondtl
Sectiondtl+Sectionmst
Sectionmst
Sectionmst+Instructor
LEGEND OF SYMBOLS
One To One Relationship
One To Many Relationship
One To Zero or One Relationship
One To Zero or Many Relationship

Figure 2

UNIVERSITY INFORMATION SYSTEM
Diagram Of Database Table Relationships

This diagram shows the flexibility of the UIS database in that data may be joined with each other in a number of direct relationships.

For example: A relationship exists between the two tables Address and Instructor. They may be effectively joined on the field: PIN. One or more address records may or may not exist for each instructor record.

WHAT HAS HAPPENED THUS FAR?

Data Base Development

In 1983, CMU initiated discussions with various database vendors to determine the future directions for each of their products. Specifically of interest to CMU was a statement of direction to develop distributed database systems. After long and tedious investigation, by 1985 RTI appeared to be the only vendor which offered a clear picture as to the problems and issues related to distributed databases; and (RTI) was working on solutions.

In the same year, we acquired INGRES for a VAX 11/780 that was used to build a new space management system. Over the course of the two years that followed, we observed the company to be one which was focused on the improving technology of their product. Performance and function increased dramatically over the next two releases and we found RTI committed to support the product finding and "fixing bugs" with the software in a timely manner.

As the need arose to replace existing production systems, the strategic decision was made to fully utilize the relational database environment. A major effort would include building decentralized, distributed information systems that would persist into the next two decades. In doing so, we would be relying heavily on the vendor to provide a software product which would meet our needs. Due to the technical nature of this effort, the vendor would have to hold an aggressive attitude toward improving the product as well. In fact, as we were pursuing our plan we were looking for partners in technology to work with us over a five year time period. RTI wanted to work with us to insure that our new systems would be successful and necessary enhancements would be incorporated into future RTI products.

CMU has installed new products such as INGRES/STAR and PC INGRES in the past 18 months and will participate in the beta test of a RMS Gateway and the next version of INGRES. As application development has evolved on INGRES, we have continued to identify problems which surface. Many are unique to CMU only because of the large amount of data presently deployed in our database. Support has been excellent in resolving these issues. The database vendor has worked with us to understand our priorities and issues surrounding those problems.

Applications Development

Sigma Systems, Inc., provides software for different computing environments and as a result Sigma development staff have acquired a broad range of experience. The Sigma partnership brings together CMU and Sigma staff who will work to implement new software. This activity is both professionally rewarding and vital for future software product evaluation.

In part because Sigma did not seek to develop its own database management system, did not attempt to design its own screen handing software, and did not develop each installation as unique software, it has been able to adhere to industry standards. The software applications use COBOL, the major data base management systems, and many of the mainframe transaction processors. As new operating system technology is available, the software could be used merely as an adaptation rather than a rewrite of the Sigma application software. New users have been able to implement SQL across different data base systems with a modicum of effort.

Machine Translation (Case 1: COBOL to SQL)

Carnegie Mellon staff have suggested further automation of the software conversion. A machine translation tool was developed by CMU in the course of the SAMS effort in order to expedite the adaptation of COBOL-based systems to SQL. Perhaps one of the most valuable pieces of work to evolve from the partnerships occurred because of the relational technology strategy. As CMU and Sigma began exploration of their partnership, a monumental task emerged of converting large quantities of COBOL code to standardized SQL. To adapt and convert a half-million lines of COBOL code by keyboarding the changes would not have been feasible within the timeframe allocated for the task and the personnel resources which were available at CMU and Sigma. Another tact was clearly called for, even though at the time neither Sigma nor CMU had done the research to explore alternatives.

Clearly some experimentation was necessary and a CMU staff member (Mr. David Campbell) set about the task of finding a better way, not only to do the Sigma conversion but other conversions as well. The strategy of partnerships with vendors of existing software raises among other issues the issue of starting with other people's code.

The basic translator program required about 3 months to write and test by Mr. Campbell and is presently converting COBOL statements to SQL statements at the rate of 250 to 300 per minute; we feel this compares favorably to the approximately 5 to 10 statements per minute using the traditional keyboarding method.

How are the Partnerships Doing?

Relational Technology, Inc.

On June 30, 1986 RTI and CMU signed a five-year (technology partnership) agreement to create a distributed database environment that will span the university's seven colleges. This agreement was the first non-governmental pact to develop integrated information systems based on a distributed database environment that includes a variety of mainframes, minicomputers and personal workstations. The implementation of this distributed environment intends that "end-users" will have access to multiple databases residing on different hardware and operating systems. It is intended that users in one department develop applications and access necessary data and records from remote departments.

A major development effort is complete which integrates student, faculty and financial data within an INGRES database on an IBM 3083. Currently CMU is jointly developing a student information system with Sigma Corporation of Los Angeles and a human resource system (HRIS) with CYBORG, INC of Chicago. These systems will run on a cluster of two VAX 8700's.

The RTI partnership has led to use of the INGRES/STAR distributed database, VM/CMS INGRES and PC-INGRES (an MS-DOS personal computer product) all of which were beta-tested at CMU in 1986 and 1987. The effort will use distributed computing resources of the university, moving data from a central system to departmental systems and to personal systems.

SIGMA

The addition of the recruiting and enrollment modules to the Sigma admissions system should affect those institutions which have the need (and skills) to employ such a product. This development will result in the first CMU administrative system software product which requires more statistical and mathematical understanding than the typical administrative user may possess. This complexity presents a problem of user-training even before the product can be marketed and installed; CMU can play a role in this transition for other institutions.

The CMU student records module is not planned as a marketable software product since the design approach will be somewhat different than at most colleges and universities. Policy and security issues will need to be addressed and resolved on each campus. Many campuses may not be philosophically agreeable to the distributed student record system. Decentralization of authority will dictate functionality and flexibility which may not be needed for most colleges and universities.

At the end of the project CMU will have a student system based on functional designs which may be considerably different than those currently being used and developed. The software and database design must permit modification and extensions. The software will facilitate use of the database management system tools--query languages, report writers, screen generators--which should provide for responsive and productive end-user data processing. A peripheral but nonetheless important characteristic of the partnership is that the software can be maintained by either Sigma or CMU. However a broad market for the CMU student records system will not likely exist.

CYBORG

THE CMU/CYBORG relationship to develop a human resource system in a higher education setting is a much more conventional approach to vendor/client relationships than the Sigma relationship with CMU. It is anticipated the CYBORG Solution Series products will be available with modifications for the higher education market place by late 1988. As implied, the CMU/CYBORG relationship calls for, first, the enhancement of the baseline product and then the conversion from RMS to INGRES SQL data base structures. The main difference from the Sigma relationship is that the relational implementation of

SAM is occurring as the functional enhancements are being introduced. CYBORG is providing consultation and review of requirements which may or may not cause their source code to be modified.

THE FUTURE

Distributed Data Base

Distributed databases will permit us to take advantage of the parallel processing effect which occurs within the software. The query or update command is analyzed by the database optimizer to determine how it may be broken down into queries by location (of where the data is stored). As queries are split into sub-queries and routed off to the processors where each subset of data exists, results can be obtained in parallel and then effectively "merged" together at the requesting node. This would be extremely effective in operations where large numbers of records are changed or several levels of restrictions are applied to obtain a retrieval.

Further work is being done to permit the definition of CPU classes in order to determine effective processing throughput. This will insure that the same processing load is not expected of a small system (e.g. Microvax), as would be a large mainframe (e.g. VAX 8700). In addition, network costs such as bandwidth, routers, and gateways will be weighed into the equation by the optimizer. This will provide further information as to which path is optimal for getting the operations completed in the fastest time possible.

Code Management System

CMU and RTI will jointly work on a code management system to manage software across heterogeneous systems. The two organizations share the objective and task of managing software development across different hardware and operating systems. Especially with some application front-ends residing across many systems (e.g. workstations), and backend software residing on hosts (e.g. mainframes), we wish to have an environment in which new software releases are tracked and installed with standard automated procedures.

New Applications and New Partners

The applications which will benefit from distributed database are numerous. Once the university data has been integrated using INGRES, the applications themselves can be migrated onto the campus network where students, faculty and staff may access them. The initial applications which appear to be likely candidates include:

- **Financial Aid Tracking System** - Here information which is relative to the specialized needs of the Financial Aid Office is kept on a local department system. This local database can contain information such as: interview history data, tracking information, packaging information. The central mainframe systems can hold information relative to awards granted, needs determined, and other data which is more critical to reside on a larger system. Through the distributed database, both of these databases will reside in the same overall database that allows the applications and clients to access information transparently. It aids in isolating critical components of the system without eliminating access. Disk space for information required only by the Financial Aid (FA) department may be used by that department; FA can control the rate of consumption. If all space is consumed, it does not preclude processing which is necessary as part of the overall campus operation.
- **Degree Audit Tracking** - Departments may maintain degree requirements upon their own workstations or local file servers. As these requirements are available, they are used periodically by the central systems for course registration validation or transcript preparation. Locally they provide immediate verification of courses outstanding to students as well as assist in advising students what choices are available in transferring from one program to another. A micro-based, PC-AT, degree audit system application has already been implemented.
- **Student Records Data Entry** - The data entry process for student records information will be moved out of the Registrar's office to the various campus units. By using distributed database to ensure transaction integrity across the network, it will be possible to access translation tables for various validation codes either locally or cached locally after retrieving from the central system. Once data has been entered, the data may be either: (1) stored in a local table, and then updated, applying

the set of entries, against the central database, or (2) updated, in real time, against the production database. Typically one could think of both types of transactions occurring depending upon the time of year.

• **Cashless Campus** - Distributed database can link databases which interface with different applications depending upon the intended usage. With one objective being "debit card" services using a student/faculty/staff ID card, various databases may exist for specific purposes. Food Service will keep information relative to contract meal plans, cash balances targeted toward meals, inventory, and sales transactions. The Campus Bookstore will keep data that is relative to cash balances targeted toward purchase of books and supplies, sales transactions, and inventory. The parking office may keep an authorization database indicating patrons of various campus parking lots. All of these systems will require transaction interface to the Student Accounts Receivable system. It may be possible that the id card technology is used as the ultimate form of authorization granted by an individual to access his/her personal information.

EPILOG

The opportunity to develop a new generation of administrative information and management support systems has been made possible in part by the timely allocation of University seed money. The confluence of recognition by the senior (CMU) administrators of the needs and the opportunities provided by the current (and near future) technology will foster a new and more effective managerial information model.

The technological and economic leverage provided by the adaptation of relational and eventually distributed relational data base systems is pervasive. Creating systems and applications in an environment e. g. INGRES has already reduced the need to completely reprogram or convert applications, if and when new hardware or operating systems are dictated. We believe that large scale administrative applications tend to last longer (2 to 4 times) than hardware systems. The financial and operational advantage of long term application tenure should not be overlooked. Indications are that many application software vendors agree and thus will create more portable applications in the future. Proprietary software/hardware/data base combinations will find niches but not broad markets. With funding provided by the University to create the data base environment and with help from the industry partners in place the momentum exists to create a new generation of administrative systems. As this momentum and its concomitant energy manifest in new applications software, the promise of the technology will be fulfilled having been made possible in large part by the partnerships.

The development and migration of applications and data bases from the central to the distributed environment will be centrally coordinated; the complete migration is expected to span the 5 year period from 1986 through 1990.

Strategies To Implement Technology To Manage and Deliver Educational Programs in a Decentralized Organization

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Abstract

The Virginia Cooperative Extension Service (VCES), operated jointly by Virginia Tech and Virginia State University, is pursuing high technology to help meet its mission of providing practical information to the people of the Commonwealth to improve their economic, social, and cultural well-being. Since 1982, VCES has been engaged in a variety of electronic projects to enhance its program management and delivery capabilities. The following are examples of VCES' technology projects, which will be described:

- In 1982, six Extension field offices were connected to VCES' computer network. By 1984, all Extension field offices (120), including offices in all the counties of Virginia, were equipped with personal computers and were linked to the Virginia Tech mainframe.
- C-band satellite receiving dishes were installed at 41 Extension sites during 1987. The teleconferencing system is providing broadcast capabilities for educational programs and staff training sessions from Virginia Tech's campus to the Extension offices across the state.
- VCES began, in 1983, transferring computer files with educational information from the Extension network to a single newspaper. Today, news releases are electronically transferred to six major Virginia newspapers and the United Associated Press, ensuring the printing of timely information.
- In 1985, VCES aggressively began to pursue interactive video as a potential method to expand its audiences. During the next three years, VCES will develop interactive video public information kiosks to be located in shopping malls and in libraries.

VCES' strategy is to stay diversified and try different technologies as they arise. The successful adoption of these technologies has resulted from administration's commitment, staff's involvement, support from other technology groups, using early adoptors to teach and promote, the use of pilot projects, and systematic evaluation. In summary, VCES' plan to integrate future emerging technologies into VCES' program delivery system will be discussed.

Extension Use of Technologies

Virginia Polytechic Institute and State University (Virginia Tech), a publicly supported, comprehensive, land-grant university, serves the Commonwealth of Virginia, the nation, and the international community by generating and disseminating knowledge in the basic human, social, and scientific disciplines through instruction, research, and Extension. Virginia Tech's land-grant missions are supported by aggressive strategies to develop computing and communications networks. The Virginia Cooperative Extension Service (VCES), operated jointly by Virginia Tech and Virginia State University, is pursuing high technology to help meet its mission of providing practical information to the people of the Commonwealth to improve their economic, social, and cultural well-being.

Since 1982, the Virginia Cooperative Extension Service has been engaged in a variety of electronic projects to enhance its program management and delivery capabilities. VCES' technological projects include a statewide computer network, computer linkages to informational data bases, satellite teleconferencing, interactive video applications, electronic transmission of information to news outlets, computer linkages with other federal and state agencies, and local area networks.

Statewide Computer Network

In 1982, VCES undertook a five-year project to develop a statewide computer network. The network was planned to connect all the Extension field and campus offices to a single computer system.

VCES has 120 field offices--108 county/city offices, six district offices, and six 4-H Educational Centers. Today, each of these offices has at least one standard hardware workstation. The standard hardware configuration includes an IBM-PC with two double-sided 5-1/4" floppy disk drives, a color monitor, a 1200-baud modem, and a dot-matrix printer. All of the PC's are equipped with an AST SixPackPlus expansion board which provides a serial and a parallel port, a hardware clock, and memory expansion. In addition to this standard package, forty offices have an IBM-PC/XT with a 10-megabyte hard disk drive, and 20 IBM-PC portables are being used by area farm management agents. Earlier generation hardware, which remains in use, are 48 full-screen terminals.

All Extension field offices are connected to the Virginia Tech computer system. The telecommunications connection to Tech's mainframe provides all Extension staff with access to the resources of the Virginia Tech Computing Center. The primary computing facility at the Center is an IBM 3090 multi-processor complex.

The majority of the Extension field offices have only one personal computer, and these are typically used for office management functions: wordprocessing, mailing list management, etc. To make maximum use of the personal computers, each Extension office in the state has been supplied with the following microcomputer software packages: YTERM, a communication package; LOTUS 1-2-3, a broadly applicable spreadsheet program; PC-FILE III, a flexible, but inexpensive, data base management program; PCXEDITOR, a screen editor for the PC which resembles IBM's XEDIT editor for its CMS operating system on the mainframe; and WORDPERFECT, a wordprocessing program.

Computer Linkages

Extension has experimented with several methods of sharing computing resources: transferring information from other mainframes to the Tech computer, networking to other mainframes, and networking personal computers. Extension makes use of two nationwide computing systems, DIALCOM and ACRES, by moving information and data to the Tech computer. DIALCOM, owned by IT&T, is a computer network which is used by Extension personnel throughout the U.S. The USDA news releases and OUTLOOK information are downloaded daily from DIALCOM and redistributed via the Virginia Extension Computer Network. ACRES provides information and agricultural news. It is operated by Farm Bureau.

Recently, Extension has begun to investigate the use of gateways to other computer systems via the Virginia Tech computer. In June 1987, a telecommunications link was installed between the Virginia Tech and Virginia Department of Agriculture and Consumer Services (VDACS) computers. The computer link is a joint project by Virginia Cooperative Extension Service and VDACS. Virginia Tech's Communication Network Services (CNS) Group installed the link and will maintain the communication equipment. The link provides electronic communication between VCES and VDACS computers and the sharing of computer applications.

Extension, using the University's BITNET node, also has electronic mail and file transfer capabilities to the majority of the other land-grant institutions. Presently, VCES is exploring the use of the National Science Foundation and the Southern University Research Association computer networks to share computing resources within the Southern Extension Region.

Local Area Networks

Extension has also experimented with the networking of personal computers. The Chesterfield Extension Office is the site for the 'Computerized Extension Office,' a model office developed to provide information for future computer development. Each agent's, secretary's, and technician's workstation is equipped with an IBM-XT, linked by a local area network. The XT's provide all staff members with sufficient computing power and storage for their own work, and the network links the workstations to a laser printer, a modem to link to the Virginia Tech mainframe, and shared data bases on the other hard disks in the office. The Chesterfield network was installed in June 1986 and a token ring network was installed in the Chesapeake Extension Office in June 1987.

These two test sites are providing valuable information about the usefulness of local area networks and office automation in an Extension office. Due to the success of these two pilot efforts, in the near future, similar networks will be installed in at less one additional office and several less sophisticated networks will be installed in smaller offices to share printers and storage devices.

Satellite Broadcasting

The creation of the Virginia Tech Teleport Facility and the installation of a 9-meter diameter C-Band satellite uplink antenna, in 1986, provided the initial impetus for the Virginia Cooperative Extension Service to explore the usage of satellite technology for information and program delivery. The uplink site presently provides two, broadcast-quality, video signal channels for transmitting NTSC standard television signals from Blacksburg. The vision, and now the reality, of Virginia Tech developing its own multi-purpose satellite communications network affords VCES numerous opportunities to explore the areas of information dissemination and educational program delivery.

In the summer of 1986, approval was given by the Extension administration to fund the placement of 25 downlink sites (at least one per planning district), to be located in local Extension offices, 4-H Educational Centers, district offices, and research stations. Sixteen additional downlink sites were proposed, approved, and became operational in October 1987. Of the 41 downlink sites located across the Commonwealth, 3 are located in district offices, 4 in the 4-H Educational Centers, 4 in research stations, and 30 in local Extension offices.

Using Virginia Tech's television studio and electronic classrooms on campus, VCES began broadcasting teleconferences for Extension staff in April 1987. Presently, an average of four programs are aired each month. Satellite broadcasts from other State Extension Services are also promoted and viewed at Virginia Extension sites. The acceptance and effectiveness of satellite educational programs are being evaluated for the first year to provide future direction for the satellite teleconference system.

Electronic Transfer

The Virginia Tech Extension Information Office (EIO) produces and distributes Extension educational information to newspapers, radio, and television outlets across the Commonwealth. In 1982 and 1983, computer terminals were installed in the EIO Offices. Given this computer capability, the office began to investigate the feasibility of electronic transfer of news releases.

Two major premises were established for the electronic transfer program. First, EIO would try a proactive system; i.e., a system in which new releases would be dumped to news outlet computers, rather than have the outlets access the Virginia Tech computer to select stories. Secondly, news outlets were approached on the basis that a customized service would be provided to meet the outlets' needs.

The service was accepted first by the Roanoke Times, a regional newspaper, and today six major Virginia newspapers and the United Associated Press are utilizing the service. This program guarantees the timely delivery of Extension information.

The EIO Office also electronically provides information to each Extension office in the state via the Virginia Tech computer link. The electronic link offers the EIO Office the opportunity to quickly get information to small dailies, weeklies, and broadcast stations via Extension agents.

Interactive Video Project

A project was planned in 1985 to actively investigate interactive video as an educational tool. The successful development of a demonstration model led to VCES being awarded a $1.2 million grant from the W. K. Kellogg Foundation for the development of public information stations to enhance the information delivery structure of Extension. The three-year grant began April 1, 1987, and employs new technology in information systems that facilitate problem solving. The technology upon which these systems will be based is referred to as "interactive video." This technology integrates large quantities of video, slides, graphics, voice, and text, permitting a microcomputer to coordinate the material for tailored presentations to individuals. Systems based on this technology are good candidates for public information stations because of the vast amount of information which can be stored on the laser disc.

The delivery stations will be located throughout the state in shopping malls and libraries. This setting will provide the opportunity for clientele to receive information in places and at times convenient to them. It is anticipated that, during the first year, 12 stations will be placed in the state, with additional stations being added each of the remaining two years. The systems located in malls will be packaged in such a manner that those interacting with the system will only need to touch the screen to select program options or control the presentation. Systems located in libraries will have the added capability of keyboards and voice recognition.

Program material will be developed in three main areas: consumer questions and concerns; horticulture; and health and nutrition. One area will be developed and tested during each of the three years.

Strategy for Technology Implementation

VCES' approach to implementing information technologies emerged from the development of a statewide computer network which began in 1982. The long range goal was to develop a computer network to enhance the delivery and management of Extension programs. The short-range goal was to meet present demand for computer-aided programs with existing hardware or hardware that was expected to be compatible with the network system and encourage software development by Extension staff.

These goals, developed in early 1982, which seemed very global at the time, have proven to be a very successful formula for implementing technologies for the Extension organization. The following statement from Virginia Tech's, "An Information Systems Strategy," drafted in 1985, describes the approach that VCES and the University has taken toward technology implementation:

> "Classical approaches to planning usually emphasize the establishment of goals. In a time where technology is growing and changing so rapidly, such a static approach is clearly myopic. What seems more fruitful is a strategic view of the University's computing and communication future--a view that attempts to articulate a growth philosophy that permits seizing opportunities when the state of technology is right. Some technological advances are clearly predictable; others are not so easily foreseen. Whatever strategic position the University assumes, vis-a-vis, computers and communication, it must be predicated on foreseeable technological advances, and flexible enough to accommodate those that are not so easily discernible."

VCES' strategy to stay diversified and remain flexible to permit seizing opportunities when the state of the technology was right has enabled the organization to be in a position to implement emerging technologies, but the keys to successful implementation has been Extension administration's commitment, staff's involvement, supportive relationships with other technology groups, early adoptors' participation, the use of pilot projects, and evaluation.

Administration's Commitment and Staff's Involvement

It is well documented that the administration's commitment and the involvement of staff at all levels are critical to any major organizational change. Commitment and involvement are paramount in the implementation of new technology because of the financial resources required, the rapid emergence of new technology, and the dramatic change in staff's skills and behavior required. Conscious steps have been planned and executed by VCES' administration to demonstrate its commitment to technology development projects and a high priority has been placed on the involvement of staff, as illustrated by the following:

- All staff received a letter from Extension's Director which described the statewide computer network as a top priority for the organization and a 25 member task force was appointed to provide direction for the project.
- The first step VCES took toward exploring interactive video was to invite about forty key staff members to a demonstration by a corporation that had successfully developed interactive video for staff training. The enthusiasm for the potential of interactive video rapidly spread throughout the organization.
- The satellite downlink project was announced at an annual staff conference only two days after a decision had been made to move forward with the project. Extension's total staff assemble only once a year. Using this opportunity to announce the downlink project eliminated "grapevine" misconceptions--everyone was told the whys and hows about the project at the same time.

- The strategy of clear communication to all staff at the beginning of a project was also used with the interactive video public information project. The project description and scope were discussed with staff by VCES' Director during Extension's first satellite broadcast teleconference.

Relationships with Other Technology Groups

To support its educational mission, Virginia Tech has excelled in the development of communications systems, computing, and state-of-the-art instructional support services. These advancements have been paralleled by the growth of the University's technology support staff. Extension, recognizing the University's vast resources and resisting the temptation to "go-it-alone," has heavily relied on the assistance from other technology groups within the University. The following are examples of how Extension has benefited from the assistance of the University's communications, computing, and other support groups:

- In 1981, with the plans for an Extension statewide computer network on the drawing board, Extension computer applications housed on a privately leased computer needed to be converted to the University computer system. Virginia Tech's Systems Development Group supervised the conversion of over seventy-five computer programs.
- The Virginia Tech Communications Network Services Department, which is responsible for the University's voice, data, and video communication systems has been instrumental in the design of data communications networks to accommodate Extension's requirements to connect its 120 statewide offices to the University's mainframe.
- The University's Computing Center's User Services staff have conducted training sessions for Extension field staff at off-campus locations. This group traditionally provides user assistance for on-campus graduate staff and faculty.
- With the installation of Virginia Tech's satellite uplink facility, a demand was created for satellite broadcast based programs. The potential for broadcast capability was obvious to Extension with its decentralized office arrangement. At Extension's request, the CNS Department deployed a team to design and install satellite receiving dishes at 41 Extension sites.
- For the past two years, a full-time CNS faculty member has been assigned to Extension to study and implement off-campus voice, data, and video communication needs. As an example of this work, the faculty member has designed and installed two local area computer networks at Extension offices. This arrangement has given the CNS management a better understanding of the University's off-campus communication needs and, at the same time, Extension has benefited from the technical assistance.
- In 1985, when Extension discovered the potential for interactive video to reach new audiences in a decentralized program delivery mode, resources were found within the University's Learning Resources Center (LRC) to assist with an interactive video project. The University's LRC Group had been experimenting with interactive video for several years and generously shared their experiences. Currently, LRC is cooperating with Extension staff on the public information interactive video project, providing video production and instructional design assistance.
- The LRC staff are also very involved in Extension satellite programming. The programs are aired from the University's studio or electronic classroom and are produced by the LRC staff.

Participation of Early Adoptors

During the implementation of Extension's statewide computer network, there was an obvious shortage of staff to conduct training and provide daily user support. With limited resources available, Extension elected not to make significant staff additions. One faculty member was hired to coordinate training, but hardly one person could have been expected to provide training for staff housed in 120 different offices across the state. The lack of users' support created frustration for the staff, but over time an informal learning network developed. The early adoptors of computers did not wait for additional formal training, but resorted to self-instruction and user groups to expand their knowledge of computers. In short, with the leadership of these early adoptors, staff organized themselves to deal with the void. Extension realizes the existence of early adoptors within its organization and other organizations and uses these resources, illustrated by the following:

- One of the major problems with a decentralized computer network is the logistics of providing training and other support functions. To address these problems, Extension has identified staff within the off-campus offices to assist with training, equipment installation, resolving software problems, and, in general, promoting computer applications. These staff include secretaries, Extension agents, and faculty. Typically, these staff members were the early adoptors of computers and self-educated to become computer literate.

- In most cases, Extension's technology pilot project sites were selected because the staff at those chosen locations had reputations as early adoptors. Using early adoptors for pilot projects minimized the effort required to deal with resistance to change.

- The Extension Computing Resources Office uses early adoptor staff to test newly developed software.

- For each satellite downlink site, a programming coordinator was identified. Staff were selected as coordinators based on their reputation as innovators. The coordinators roles are to: identify audiences, actively promote satellite broadcasted programs, involve other staff to expand the appreciation for the delivery method, and create a total educational program around each broadcast.

- A computer link was successfully established between Virginia Department of Agriculture and Consumer Services and Extension, because the staff from both organizations involved in the project could see the potential for such an electronic linkage. A conscious decision was made to avoid staff that would construct barriers, resisting the technology.

Use of Pilot Projects

Pilot projects have been used extensively by VCES to test emerging technologies and positions the organization for full-scale implementation. In addition to the obvious benefits of pilot projects, VCES has seen that pilot projects heighten staff awareness of new technologies, visibly demonstrate the administration's commitment to new modes of operations, and prepare staff for future change. Pilot projects also permit the organization the option of abandoning a technology if it doesn't develop as anticipated. The following are examples of VCES pilot projects:

- VCES' statewide computer network began with six offices equipped with computer terminals and dial-in capability to Virginia Tech's mainframe. The pilot project readily identified problems associated with a decentralized operation--equipment delivery and installation, telecommunications problems, staff training, and hardware maintenance. On the positive side, the benefit of electronic communication of timely information, the usage of a hi-tech office, and the increase in staff morale were observed.

- In 1982, VCES purchased several multi-user and personal computers and tested both systems in field offices. Although, at the time, the multi-user microcomputer seemed the reasonable approach, the 'PC' emerged as the standard. VCES was in a position to move rapidly and implement PC based systems.
- With the widespread use of personal computers and the abandonment of multi-user micros, VCES installed a PC network in one Extension field office in 1986. The pilot project allowed VCES to identify how local area networks could benefit the local offices' office management and program delivery computer operations. Also, the experiment yielded a working configuration that could be replicated. The success of the project was recognized by another Extension field office which obtained funding to install a network patterned after the pilot configuration.
- Extension's use of interactive video systems for information delivery began with the development of a demonstration model. The model was used to evaluate hardware and software components, but, more importantly, the model demonstrated to staff the concepts of the merging of computing and video technologies. Having successful demonstrated the potential of interactive video with the pilot test, private funding was obtained to fully implement several public information systems.
- This summer a telecommunications link was installed between the Virginia Tech and Virginia Department of Agriculture and Consumer Services (VDACS) computers. The first computer application where both agencies computers will collect and share data is not expected until January, but there is already growing interest in additional applications using the linkage.
- A pilot project has recently been started with desktop publishing. The purpose of the project is to develop operating procedures for regional desktop publishing. The project will include testing methods for electronic routing, evaluation of desktop publishing systems, determination of training requirements, and documentation of staff acceptance.

Evaluation

The Extension organization, national and state, places a high priority on evaluation as part of the program planning process. All Extension staff annually develop plans of work, which includes planning, implementation, and evaluation components. Likewise, Extension's technology projects have included evaluations:

- An initial step in Extension's computer project was to conduct a needs assessment. The study focused on the question, "How can computers increase the organization's effectiveness and efficiency?" The results of the study have been, for five years, to set priorities for computer equipment and software.
- Evaluation results have been use to justify expenditures for technology projects.
- One-quarter of a faculty position has been assigned to Extension's public information project to evaluate the project.
- An extensive evaluation, using qualitative methods, was conducted of the local area network project. The evaluation tracked staff's reactions and behavioral changes.
- Currently, a study is being conducted to determine how staff are using electronic mail. The results will be used to assist staff in their determination of appropriate communication methods.

Future Plans

For the past five years, VCES has taken a diversified approach to implementing emerging technologies and has maintained a flexible position in order to expand its use of proven technologies. Realizing the vast number of technological advancements on the horizon and not willing to be content with past successes, VCES organized a task force last Spring to develop strategies for implementing emerging technologies. On November 18, 1987, the committee's report was presented to the Extension Administration. The following is a summary of committee's recommendations:

Needs Assessment - Some would say that VCES has been driven by new technologies-- installing hardware and then asking the question, "How can this technology be used?" In order to seize opportunities, VCES has moved quickly to implement several technologies. Now, with a variety of program delivery methods in place, VCES must determine informational needs and preferences of clientele, and assess current and future information delivery methods to determine their appropriateness and effectiveness.

Resources Networking - VCES has just recently began to investigate linkages with other computer systems, but already recognizes a great potential for sharing resources. VCES will continue to pursue computer links with other agencies, institutions, and organizations for sharing of information and data bases. VCES will also actively explore strengthening relationships with other agencies to foster the cooperative efforts in research, data collection, and standardized information delivery mediums.

Information Delivery Systems - Emerging technologies are rapidly changing the way we think about delivery of educational information. Extension should continue to develop, implement, and evaluate electronic systems to increase program delivery capabilities, efficiencies, and effectiveness. The greatest challenge will be the establishment of standards and coordinated procedures to permit the employment of multiple approaches to information delivery.

Knowledge Base Systems - Computer-assisted instruction (CAI) and computer-based training (CBT) are an integral part of many organizations, providing alternatives to training personnel at a distance. Also, computer technology offers new options for diagnostic services, potentially replacing one-on-one personal contact services. The potential for successful computer-assisted instruction and knowledge systems within VCES are numerous, yet minimal effort has been devoted to this area. systems. As an outgrowth of VCES's interactive video, increased activities are expected in the areas of laser disk and expert systems.

Staff Development - Two major challenges exist for Extension related to staff development and emerging technologies. First, programs need to be expanded to maintain staff's competency in applying various technologies. Secondly, VCES should utilize the appropriate technologies in providing staff development opportunities.

Capital Budget - For the past six years, VCES has had a modest capital budget for technology projects. Today, the number of technologies competing for those dollars is increasing. VCES should establish capital budgets to recognize the fiscal demands required to maintain a diversified and flexible position. And, VCES plans to develop a procedure for prioritizing capital expenditures and allocating development funds.

Organization Structure - The present VCES technology support groups have evolved over the years without serious considerations being given to the organizational structure required to support emerging technology projects. An organization should be put in place that complements the incorporation of new technologies. Responsibilities for development, implementation, support, staff development, and evaluation should be clearly defined.

Summary

VCES, like many organizations, is at a crossroads related to the implementation of technologies. Many of the questions related to computing and communications are much clearer than in the past. The majority of the computing needs for Extension can be handled by personal computers or networks of personal computers. Computer linkages to centralized mainframe computers can provide the major computational services and repositories for information data bases, at least for the short term. Communication networks are in place; although, separate and relatively expensive. We are now in an information era with technologies merging to create information systems - incorporating activities in computing, communications, data bases, and new data storage alternatives.

Any strategy for the future needs to consider how communications and storage media technologies will advance and how they will be integrated. Information systems strategies will force decisions regarding how information will be stored and retrieved.

The development of strategies for the future technologies in VCES will start by addressing the following questions:

- What methods of information delivery are acceptable to staff and clientele?
- To what extent should voice, data, and video communications be merged?
- What is the future for two-way video systems?
- Where should information be stored?
- What are the cost considerations for communication systems compared to decentralized information data bases?
- How can decentralized data bases be updated?

The answers to these questions are expected to direct VCES to a flexible position for technology implementation for the next five years.

References

"Information Systems and Communication Technology," Reference Document: Needs Assessment for The Food and Agricultural Sciences, January 1984.

Hussey, G. Art, "Electronic Technology, Impact on Extension Delivery Systems," Electronic Technology Task Force Report, May 1985.

Virginia Tech Computing and Information Systems, "An Information Systems Strategy," November 1985.

Canup, Terry, "Efficient Program Delivery to Urban Audiences through the Use of Video and Widely Adopted Consumer Technologies," February 28, 1986.

McAnge, T. R., Jr., "Virginia Cooperative Extension Service, Computer Network Status," March 1986.

Canup, Terry, "A Proposal for Innovative Program Development Through Systematic Programming Research," March 5, 1986.

Murphy, William F., Jr., "Technology and VCES," July 16, 1986.

McAnge, T. R., Jr., "Virginia Cooperative Extension Service, Satellite Downlink Project Implementation Plan," October 31, 1986.

Nichols, James R. and Mitchell R. Geasler, "The Future of Agriculture, Forestry, Food Industries and Rural Communities in Virginia - Serious Challenges & Extraordinary Potential," 1987.

Murphy, William F., "Efficient Computing: Mainframe/Microcomputer Linkages," January 1987.

PA-NECI, "Future Extension Delivery Methods," March 27, 1987.

Pinnock, Theodore, "The Importance of Knowing Your Audience," April 16, 1987.

"Extension Transition - Bridging the Gap Between Vision and Reality," Report of the Futures Task Force to the Extension Committee on Organization and Policy, November 1987.

FOURTH GENERATION LANGUAGES IN A PRODUCTION ENVIRONMENT

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SQL and DB2 are touted as the productivity tools to cure the "ills" of long application development cycles and of user-unfriendly software. Relational database management packages which use 4GLs are said to "have come of age." But where are the large applications in production today to verify or to demonstrate the stated advantages? This paper:

(1) explores the literature for and against 4GLs;
(2) describes several large applications written with 4GLs;
(3) details the San Francisco State University experience of creating a Student Financial Aid application using ORACLE, a relational DBMS which uses SQL.

Both hardware and software aspects of the new development tools will be discussed.

FOURTH GENERATION LANGUAGES IN A PRODUCTION ENVIRONMENT

INTRODUCTION

During the last few years, much of the popular MIS literature has focused on software methods to increase data processing efficiency and information availability. Terms such as "fourth generation languages," "user friendly interfaces" and "database management systems" have been thrown about, often in the same paragraph as references to 30:1 improvements in programmer productivity.

This paper first presents a commonly used framework to explain "what the shouting's all about." From that foundation, it next focuses on the use of one 4GL, the Structured Query Language (SQL), by two relational database management systems, DB2 and ORACLE. Specifically, the extent to which these software packages are being used in a production environment in both industry and in institutions of higher education is explored. Finally, the ORACLE implementation of a Financial Aid system at San Francisco State University is described in detail.

WHAT IS A FOURTH GENERATION LANGUAGE?

The 4GL attempts to solve many of the problems of the traditional application development cycle. "Third generation" procedural languages such as COBOL, combined with file structures such as ISAM and VSAM, have been the work horses of DP shops for more than a decade. Unfortunately, the development cycle for a 3GL application is quite lengthy, and is not easily accommodated to changing user requirements.

For the purposes of this discussion, the important elements of a 4GL are:

(1) a database management system (DBMS);
(2) a data dictionary;
(3) a query language;
(4) a screen/report generation facility; and
(5) a programmer's "workbench."

(1) A DBMS. The first item on the above list, the DBMS, is critical to the 4GL because it allows data relationships to exist independently of applications and facilitates data

sharing with concurrency control. The DBMS thus allows application developers to concentrate on products more than on the physical structure of the data. Users access views of the data, also controlled by the DBMS.

Two models are common for DBMS packages: hierarchical and relational. A hierarchical DBMS, such as IBM's Information Management System (IMS) or Information Builder's FOCUS, presents data to users in a tree-like structure. To the user, each record resembles an organization chart; the top level is known as the "root" which identifies the record and may contain the most commonly accessed information in the record. Lower level segments of the record ("child" or "dependent") contain some set of data elements that are logically related to each other.

The hierarchical model allows variable-length records consisting of one root segment plus any number of dependent segments. The DBMS accomplishes this flexibility by using a set of pointers, chains, physical positioning, directories and bit maps that indicate connections. It is up to the data base designer to establish physical data base representations that result in processing efficiencies, to group data elements that are logically related, and to create segments by considering how data will be accessed by application programs. Paths, or logical views, are defined by the types of data base segments that can be accessed and by the kind of access that is permitted, such as read only, read/write, etc.

The two major advantages of the hierarchical model are: (a) it is a well established concept and implementation, and (b) it handles large volumes of data efficiently. The major disadvantage is that the supporting data structure is inflexible and requires substantial planning for optimum performance.

The relational DBMS, such as IBM's DB2 and Oracle Corporation's ORACLE, presents data to users in the form of tables of rows and columns. This is a more user oriented view. The user is isolated from the physical storage of data. A table consists of one record type, housing a fixed number of fields. There is no explicit sequence by which rows (records) within a table (file) are organized. A set of tables can be accessed by specifying relationships between tables in order to develop useful sets of data.

There are three basic operations that a user can specify in a relational data base: Select, Project and Join. In each, one or more tables are manipulated, resulting in the formation of a new table. The Join operation best illustrates the power of a relational DBMS. It takes full advantage of the segmentation of data into usable pieces (tables) that can be retrieved and combined when necessary. The user then extracts information of interest from a table containing "joined" elements from database tables.

Flexibility is the major advantage of the relational model. It can easily adjust to changing information requirements. Unlike hierarchical DBMSs, relational data bases are not built with a limited number of logical views or access paths. Their access paths are specified by the user. This flexibility contributes to the major drawback of this model, which is performance. Users may not select the optimal access path, and may not state their data requests in the manner most efficient for the DBMS. The DBMS must do more work for the user, which impacts the performance of this type of data base.

(2) A Data Dictionary. The data dictionary is a mechanism for defining data attributes and establishing relationships between data items. The data dictionary serves the important function of specifying, in a central location, such things as the types of validity checks that have been applied, who has update rights to the data item, security levels imposed and other names by which this data item is known. These attributes of the data item are provided when placing it in the data dictionary.

(3) A Query Language. A high level query language is generally defined as a user-oriented facility for the creation and retrieval of data in a data base. Extending this further, a high level query language also provides transparent navigation of a data base as well as a "natural-language-like" qualification of the query. SQL, the Structured Query Language that is the main interface to both IBM's DB2 and Oracle Corporation's ORACLE, has been accepted as the American National Standards Institute (ANSI) standard database manipulation language.

(4) A Screen/Report Generator. A 4GL must be able to paint screens and generate reports with ease. The screen painting facility allows the creation of appropriate display screens for the entry and/or presentation of data or information. A report generator provides similar capabilities for information derived from the data. These features should not be dependent on an application generation tool; they should allow access to data stored or to be stored in the data base without the need to generate application code.

(5) A Programmer's "Workbench". This component of a 4GL environment contains tools to increase the cost effectiveness of programmers. Commonly, a "debugger" for researching code errors is among the utilities in the workbench. Code generators have been another major innovation. Application development systems, the next logical step, allow the construction of entire application systems or subsystems using "canned" subroutines that have the potential of cutting coding time by forty percent. Finally, the ideal 4GL also includes a tool that improves the production of system and user documentation. The combination of the data dictionary and the right tools from the programmer's workbench can virtually automate the production of documentation.

WHERE ARE THE SQL PRODUCTION SYSTEMS?

As was mentioned in the Introduction to this paper, only two relational database management systems using SQL will be discussed here. A general description of the requirements of each product, DB2 and ORACLE, is given below.

IBM released its relational DBMS product, DB2, in 1983. Judged by the industry to be a "relatively lackluster" DBMS offering since 1983, IBM announced a new release of DB2 in 1986 which improved its performance sufficiently that IBM repositioned DB2 as its broad-based, production-level database management system. The products which define DB2 include:

(1) Structured Query Language (SQL);
(2) Data Extract (DXT);
(3) Query Management Facility; and
(4) Utility programs that facilitate workstation access.

To implement these four products, operating system releases must be carefully synchronized. For example, DB2 requires MVS/SP Release 1.3 or MVS/XA release 1.2. To use the Query Management Facility, GDDM Release 3 is required. If CICS is to be used, then its Release 1.6 is required.

To estimate the storage space required for a DB2 implementation, Walsh (1987) recommends: "Determine how much it costs to store information in existing data base structures or files and simply triple that amount for the number of months it will take to complete the conversion...the rule of thumb is that a DB2 data base requires twice as much space as an equivalent sequential file."

The ORACLE product has been available since 1979. Its first release by Oracle Corporation of Belmont, California, was based on the IBM System R, SQL. In 1980, ORACLE was rewritten in "C".

As of 1986, ORACLE had been ported to about twenty different minicomputer vendors' hardware. It has been cited as having 14.6% of the minicomputer DBMS market, thus making it the number one vendor of same. The development machine for the ORACLE product is the Digital Equipment Corporation's VAX minicomputer.

ORACLE has recently been migrated to different sized hardware -- mainframes and microcomputers. ORACLE is marketed as a user's DBMS, and uses SQL consistently throughout all its modules. As of Release 5, the modules which comprise ORACLE include:

(1) SQL (for data definition);
(2) SQL*Plus (for report writing and user queries);
(3) Pro*ORACLE (for 3rd generation language interfaces);
(4) SQL*Design Dictionary; and
(5) SQL*Forms (for screen painting and online processes).

Oracle Corporation's decision to rewrite its package in the "C" language has eased portability of the system. As systems programmers upgrade operating systems for users, however, there must be careful synchronization of the "C" compiler for ORACLE so that SQL statements perform in a standard fashion.

As with DB2, ORACLE users notice that, as the complexity of transactions increases, response times slow (see discussion below). This performance issue is also well known to vendors of third-party software which use ORACLE. In response, both IBM and Oracle Corporation are beginning to discuss microcode implementations of their product in future releases. This "turbo" feature bears watching as large production systems are developed.

DB2 Use in Industry. In a 1987 _Datamation_ poll of IBM customers (Carlyle), many corporations developing large-scale production systems in DB2 are "reluctant" to discuss them. The IBM Guide user group claims that over a thousand DB2 licenses exist in the United States.

Seven large-scale operations which have been quoted as using DB2 in a production mode are:

(1) DuPont;
(2) Travelers Insurance Companies;
(3) New York State Retirement Systems;
(4) Metropolitan Life Insurance Company;
(5) U.S. Navy Retail Logistics;
(6) Deere and Company;
(7) St. Paul Companies (medical liability insurers).

DuPont employees refer to its use of DB2 for "strategic" aspects of the corporation. Travelers Insurance is on record as using DB2 for its "strategic" Customer Information File. The New York State Retirement System was a DB2 beta test site in 1984, and currently quotes a database size of between 20 and 30 gigabytes. U. S. Navy Retail Logistics is creating a large-scale DB2 prototype to test Texas Instruments software which automates the systems design process.

Some statistics are available from these agencies regarding performance measures. The New York State Retirement System, for example, has quoted ten database calls per second with response times below three seconds. Deere and Co., by contrast, has noted that as transactions become more complex, response time slows significantly.

Charles Schwab and Company performed a DB2 benchmark (Computerworld, 1987) which found DB2 limited to 18 transactions per second (tps) for their application. IBM quotes a 47 to 50 tps for production purposes. The source of this discrepancy, according to Schwab officials, is the record locking mechanism used within Release 2 of DB2: "...with 100 terminals, the locking became so extensive that DB2 crashed, along with CICS."

DB2 Use in Education. The OASIS project, a research and development project currently underway by a consortium of IBM, Information Associates (IA), and three campuses within the California State University System, has been approved to rewrite the IA Series Z software to operate under DB2. This is the only DB2-based production project within institutions of higher education discovered by this reviewer. The three campuses, CSU-Long Beach, CSU-Los Angeles and CSU-San Luis Obispo, have only begun the conversion of "Series Z" (currently written in COBOL) to SQL and DB2. Completion of the OASIS project is scheduled for 1990.

ORACLE Use in Industry. Although the ORACLE product has been on the market since 1979, none of the technical/trade periodicals reviewed by this author carried articles regarding its use in industry. The publications of computer users' groups, however, did lead to several applications based in the ORACLE DBMS package. Three will be discussed here: (1) Byer of California; (2) Fritzi Corporation; and (3) Solomon Brothers.

Byer of California and Fritzi are women's clothing manufacturers. The ORACLE DBMS is used by Byer for data definition and entry for their order processing system. Fritzi Corporation also uses ORACLE for their order entry and billing system. Both manufacturers are running their systems on Prime minicomputers. Screen definitions are not considered complex, and no performance problems have surfaced. Neither company is presently using SQL*Forms for screens in the production environment, but both are in the process of developing them. SQL has greatly enhanced their programmer productivity; both have fewer than ten programmers supporting their applications.

Solomon Brothers, the financial management firm, as of the summer of 1987, uses the ORACLE DBMS in a production mode on four of its Prime minicomputers. They have also installed SQL*Forms on a fifth Prime, and are in the process of developing screen-based systems.

ORACLE Use in Education. During the past six months, several medium-sized universities have either implemented or begun development of ORACLE-based administrative software systems. The State Universities of West Virginia, for example, are beta testing the student information system package offered by Systems and Computing Technology, Inc. (SCT), which has just been rewritten in ORACLE. California State Polytechnic University, Pomona, has begun development of its student applicant system in ORACLE on a Prime minicomputer. A large university, San Francisco State University, has developed a Financial Aid application using ORACLE Release 5. This development is discussed next.

A 4GL PRODUCTION SYSTEM AT SAN FRANCISCO STATE UNIVERSITY

In June, 1987, San Francisco State University received its copy of ORACLE Release 5 for installation on a Prime 9750 minicomputer. Three months later, the ten-year-old (previously COBOL batch) production system was rewritten into an ORACLE database system, complete with online screens, reports and documentation. In January 1988, the system goes into test production in parallel with the old version, processing transactions from approximately 25 terminals. The test includes two new application modules beyond the scope of the original Financial Aid system.

San Francisco State University (SFSU) is one of the nineteen California State Universities. With a headcount enrollment of 26,000, SFSU's Financial Aid recipients number over 8,000. The decision to experiment with a relational database management system for development of a Financial Aid application was strongly influenced by a grant of the ORACLE DBMS product from Prime Computer, Inc. The quoted cost of ORACLE Release 5 exceeds $40,000.

Among the great benefits of this development are user satisfaction and greatly enhanced programmer productivity. User requests for changes to tables (via the data dictionary) and screens can be implemented, for example, in less than a day. Among the drawbacks experienced by SFSU are costs of hardware upgrades and already visible response time degradation.

During the four-month prototyping phase, SFSU has upgraded its hardware support for ORACLE Release 5 from a Prime 9750 with eight megabytes of central memory to a Prime 9755 with 14 megabytes of central memory. Prior to the upgrade, the four-person analyst team could "freeze" the minicomputer and bring down ORACLE by running four simultaneous processes. Counts of page faults per second during this test exceeded thirty.

Since our main student information system is on a different computer, we use a combination of SQL and COBOL to load and update the Financial Aid tables. This procedure currently requires over four hours of nightly batch runtime by the ORACLE system.

Our most complex screens (developed using SQL*Forms) contain over 80 background processes. We have experienced up to ten second delays while ORACLE processes screen input, runs a background COBOL routine (a third party Needs Analysis program), and returns the results to the screen. The Student Financial Aid Budget and Resources screens, which contain complex computations within SQL*Forms, have taken twenty seconds to paint with four users accessing the application.

The Financial Aid office users, however, are ecstatic with the result of this prototyping experiment. In addition, all programmers within Computing Services are anxiously awaiting their opportunity to develop an ORACLE production system. Management within Computing Services is delighted with the ORACLE solution to the system documentation dilemma as well as with the short training period required of new analysts.

CONCLUSION

The popularity of DB2 and ORACLE within the past few years has grown much more quickly than the actual development of production systems using either database management system. The advantages of relational database management systems -- mainly flexibility and heightened programmer productivity -- are apparent in the applications discussed above. At San Francisco State University, for example, the prototyping of a complex, seven-module online application using ORACLE has been a "win-win" situation. The disadvantages of 4GLs and relational DBMS packages, however, remain; poor response times for complex transaction processing and doubled space requirements (both in central memory and disk storage) are real limitations of current implementations. Future releases of both packages hint at microcode, or "turbo", enhancements. MIS shops choosing to implement SQL with relational DBMS packages prior to that time should be prepared to supplement hardware budgets and to rely on user fascination with the query capabilities for positive reinforcement.

REFERENCES

Babcock, Charles, "Users: DB2 Chokes on Volume Test." Computerworld, 27 July 1987, p. 1.

Carlyle, Ralph E., "DB2: Dressed for Success." Datamation, March 1, 1987, pp. 59-62.

Farin, Jeff and Nazario, Amor, "DBMS Basics." Infosystems, June 1986.

Ferg, Stephen, "Data Independence and the Relational DBMS." Datamation, November 1, 1986, pp 103-106.

Juris, Robbin, "Digging in on the Mainframe DBMS Front." Computer Decisions, February 9, 1987, pp. 30-32.

Kull, David, "Beware the Benchmark." Computer Decisions, February 9, 1987, pp. 48-51.

Kull, David, "A Rocky Road to RDBMS." Computer Decisions, December 2, 1986, pp. 40-41.

Mann, Douglas D., "ORACLE vs. IM/VE Report." Internal memorandum, Control Data Corporation Professional Services, October 18, 1986.

Maynard, Christopher, "Fourth Generation Gap: 4GLs Aren't a Panacea." Information Week, September 28, 1987, pp. 40-43.

Patterson, Phil and Greene, Evan, "Database Models - Network vs. Relational - A Thoughtful Comparison of Marketplace Fit." A paper presented to the Prime Systems Symposium III, May 19-22, 1985. 12 pp.

Patterson, Phil, "Fourth Generation Languages Implementations." A report prepared for Prime Computer, Inc., October 1985. 11 pp.

Prime Computer Inc., Prime ORACLE User and Reference Manuals. Natick, Massachusetts: Prime Park, 1985.

Snyders, Jan, "Installed a DBMS? You've Only Just Begun." Infosystems, September 1987, pp. 40-42.

Snyders, Jan, "Past Tense, Future Perfect?" Infosystems, January 1987, pp. 26-32.

Stevens, Lawrence, "The SQL Standard: Portability Pitfalls." Computer Decisions, August 26, 1986, pp. 26-29.

Verity, John W., "IBM's DB2 Gets Big Push." Datamation, March 15, 1986, pp. 24-26.

Walsh, Myles E., "So You're Considering DB2." Infosystems, February 1987, pp. 52-56.

"Who's Out First?" Computer Decisions, October 7, 1986, p. 13.

AUTOMATED DESIGN TOOLS: PARADISE OR PROMISES?

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ABSTRACT

The advantages of using automated design tools to assist with the design of complete systems, individual applications, or data structures have been touted in the literature and by vendors over the past few years yet few CAUSE member institutions report using these tools today. A 1986 survey of 400 CAUSE member institutions found that of 186 respondents only 3% use automated design tools for systems design, 13% use them for applications design, and 10% use them for data structure design. This report will review the current status of automated design tool technology, and feature reports on the use of automated design tools by three CAUSE member institutions.

I. A REVIEW OF AUTOMATED DESIGN TOOLS

PURPOSE AND SCOPE OF THE TOOLS

Automated design tools are often collectively referred to as CASE (Computer Aided Software Engineering) tools. CASE can be viewed as CAD/CAM for codesmiths, or in the broadest definition as the automation of anything a human does to software. Early (first generation) CASE was limited to graphics aids for the creation of data flow diagrams and structure charts, and various types of code generators. In much the same way that CAD/CAM has tied graphics to design metrics and engineering rules, CASE is integrating with other phases of the design life cycle, and automatically generating significant pieces of software and documentation. The degree to which the dream of automated programming, or the "programmer in a box" notion can be realized is subject to dispute. Brooks notes that any system which can generate code from specifications is forced to seek high levels of generalization. "It is hard to see how such techniques generalize to the wider world of the ordinary software system, where cases with such neat properties are the exception. It is even harder to imagine how this breakthrough in generalization could occur."[1]

CASE tools are gaining popularity, and the scope of these tools continues to increase. Maintenance concerns are being addressed by structured retrofit, data dictionary, and source code management products. Debugging tools are becoming more sophisticated, and the graphics tools which we categorize most closely with CASE are constantly growing in features and usefulness. "Now, CASE tools are starting to link those squares and ovals to the logic of structured design methodologies. Not only can designers speed up the rote job of drawing diagrams, but they also can use CASE tools to perform basic error checking. Some of the more sophisticated CASE wares can check details, right down through tree diagrams in which each function is decomposed into more detailed elements."[2] The reports in this paper demonstrate the wide scope of uses to which CASE tools are being put in three CAUSE member institutions.

LIMITATIONS OF THE TOOLS

There are some amazing stories of productivity increases due to the use of CASE tools. "..The application, which was originally expected to cost $268,000 was completed for a mere $30,000... We elected to use Application Factory for a 60-day trial and see what effect that would have on the overall project. We were surprized to find we could get the whole project done in the 60-day trial with just two people."[3]

While boasts of great productivity increases in specific instances are interesting, most managers would like to have a more defensible metric for measuring changes in productivity. While many shops have no consistent measure of software development productivity in place,a recent survey by Infosystems found that sixty nine percent of the respondents reported that they mearured programmer productivity, and that a surprising fourty six percent of those reporting were using function point measures.[4] It is interesting that several of the original producers of CASE tools are now vending productivity measurement software and methodologies.

The inability of CASE tools to help with program maintenance is a frequent complaint of new CASE users. "About two years ago we installed Pacbase, a comprehensive development system. Users were enthusiastic, and the project team was enthusiastic... We deinstalled it a year ago. Pacbase's maintenance works on applications developed with Pacbase, but for our existing systems we couldn't make it work."[5]

Another frequently limitation of CASE products is programmer acceptance. "It's difficult to get developers-the programmers and analysts-to use them. ..they don't see the tool as something that will increase their own marketability. Another reason is that all tools have some limitations. You get to a point where an application generator can't handle a particular problem. With the demand to provide users with perfect customization, you wind up having to program in COBOL anyway."[6] The level of integration of the components of a particular CASE tool with an installations existing DBMS and other software is also an item of frequent concern. Some software vendors, Software AG for example, are making significant strides in the integration of automated design tools with their existing family of development and operational products.

THE FUTURE OF AUTOMATED DESIGN TOOLS

Automated design tools are currently offering meaningful assistance to software development, and three such instances are reported in this paper. Especially helpful is the data dictionary integration which offers a single, controlled repository for forms, screens, procedures, data definitions, and data element usage mapping. The functionality of automated design tools and data dictionary features is certain to continue to increase in quality. Artificial intelligence and expert systems advances may result in improved CASE tools. Some leading software engineers doubt if artificial intelligence will be of much help to software development. "...Most of the work is problem-specific, and some abstraction or creativity is required to see how to transfer it."[7] Some experts believe that expert systems hold more hope for increasing programmer productivity and quality. "The most powerful contribution by expert systems will surely be to put at the service of the inexperienced programmer the experience and accumulated wisdom of the best programmers."[8]

The following reports show how three different automated design tools have been integrated into the design life cycle, and used to provide meaningful improvements in the software development environments at three CAUSE member institutions.

II. BOSTON UNIVERSITY - AN IMPLEMENTATION OF PREDICT

INTRODUCTION

Boston University is an independent coeducational, nonsectarian university located in Boston, Massachusetts. The university has a full-time equivalent enrollment of approximately 21,000 students and a faculty that numbers nearly 2,500. The University consists of sixteen schools and colleges and a medical campus.

COMPUTING ENVIRONMENT

University Information Systems provides the University's main adminstrative information processing support. An IBM 3090-180 mainframe running under MVS is used for mainframe administrative systems. Work is underway to expand an existing local area network, currently connecting most of the University's academic locations, to the main adminstrative processing site. This expansion of the network will assist in the distribution of the University's mainframe systems throughout the schools and colleges.

PRODUCT OVERVIEW

Predict is a mainframe data dictionary package, developed and marketed by Software AG. Predict is utilized with the database management system ADABAS and the fourth generation programming language Natural, both of which are also Software AG products. In the past, Predict has typically been used by organizations, such as Boston University, to record physical and logical representations (Userviews) of ADABAS files. Using Predict utilities, file definitions were generated to provide programmer access to ADABAS files. An additional use of Predict has been to document the data base environment by recording file and data element descriptions.

FUTURE DIRECTION

One of the future directions of Software AG is to more fully integrate their database products, while utilizing the Predict dictionary as a core system. Recent examples of this direction have included the introduction of a facility which, at the time program object code is generated, automatically records cross-reference information in the dictionary about the program, its processing components, (e.g. subroutines, maps) and the files and fields that they access. In addition, verification rules may now be recorded for data elements in the data dictionary and pulled into programs as a means of standardizing edits and reducing redundant coding.

INTEGRATION WITH THE DESIGN LIFE CYCLE

One of the Data Administration strategies utilized at Boston University is to integrate the data dictionary within all phases of the design life cycle. As a central repository for documenting the University's data, the data dictionary should provide systems developers and end users with the ability to obtain reliable information about the data and the functions available to access the data. By actively utilizing the data dictionary as a design tool throughout system development, the perception of system documentation as an obstacle to progress is avoided. Dictionary tools available through Predict are enhanced by inhouse tailoring and extension of the data dictionary. They are also supplemented with software packages available for use with Macintosh personal computers.

Entity modeling is employed as one of the techniques to analyze data requirements by graphically representing the organization's entities and the relationships between them. The fundamental rules about the the way in which data is used in the organization are also represented in these models. The use of this data modeling technique has proven to be very successful in promoting communication and in developing a common understanding of data. It also serves as a stable and lasting model of the organization, a basis for naming conventions and a first-cut representation of data base design.

Once entity models are finalized, the entities are reflected in the data dictionary as entity files (refered to as "standard" type files in Predict). These entity files become the central source for data element names, attributes and definitions. The standard attributes of fields within entity files are copied forward to form the actual fields within ADABAS files as well as "userviews" of these files. This is used to ensure ongoing consistancy of data element attributes and it also allows data elements to be defined only once, in the entity file, regardless of the number of physical files in which they may eventually appear.

Data element names are made up of an abbreviated form of the entity name, the domain class (e.g. identifier, flag, date, code, etc.) and one or more words to provide meaning. We have developed functions to support dictionary maintenance which check for use of standard abbreviations when new data elements are named. The abbreviation table used to support this function is also used to translate the abbreviated data element names into full words within data dictionary reports.

End users are actively involved in the development of entity models and in defining data elements, since they have the most complete business knowledge of the data. A modified version of the standard Predict functions has been assembled to support end user involvement throughout the system design life cycle. Included within the tailored data dictionary functions are options allowing documentation for files, fields, systems, functions and maps (screen layouts) to be recorded. To support standardization, guidelines regarding the type of questions to be addressed by the documentation are provided as part of online dictionary functions. An interface is also included to a "screen painting" facility which allows system developers and/or end users to jointly develop draft images of online screens during the system design process. The finalized screen layout is reflected as part of the lasting documentation for online functions.

DISTRIBUTED INQUIRY AND MAINTENANCE

The availability of accurate, informative and complete system documentation supports an organization-wide objective of distributing the functionality of existing mainframe systems to University departments. The increased awareness of existing systems helps to reduce costly duplication of both data and processing of data.

The distribution of data dictionary maintenance is an issue which has been addressed through developing multiple update profiles for the data dictionary. System developers are given a data dictionary maintenance profile which allows them to represent data requirements for new files or modifications to existing files. This is accomplished through the creation of Predict "concept" files. The use of "concept" files allows system developers to analyze several design options while utilizing data dictionary tools to verify conformance with Data Administration standards. The creation of the physical ADABAS file and generation of logical views of this file are performed by Data Resource Management following a file design review process. This review process weighs factors such as flexibility, data redundancy, semantic clarity, efficiency, security, programmer ease of use, and ongoing data integrity to determine an optimum design.

An additional data dictionary maintenance profile is provided to end users to promote their active involvement in the system design life cycle. This profile allows them to view existing file descriptions and to update definitions of data elements for which they are the data trustee. Both Data Administration and the data trustee must approve data element definitions before they are finalized within entity files. Various report options are also made available through this dictionary application to facilitate documentation review.

NEW OPPORTUNITIES

Data dictionary profiles are currently being enhanced to allow more extensive documentation to be recorded regarding systems, applications, online functions, programs and maps, in addition to files and fields. Relationships between online functions, the system(s) which they are part of, and relationships to sub-functions and programs invoked within functions may all be reflected in the data dictionary. The use of keyword/subject searching has also been built into this enhanced version to facilitate inquiries. In addition to supporting documentation of implemented University application systems, the capability to centrally document and analyze business models is regarded as a potential future use of the Predict data dictionary. As opposed to the entity model, which documents data relationships, the business model reflects important business activities of the organization including hierarchical relationships between business functions.

As analysis progresses forward to file design, it is envisioned that information gathered in business modeling and translated into function specifications may be utilized to automate logical access mapping. This cross-referencing of functions and their data access requirements, combined with statistics regarding anticipated frequency of function utilization, may be used as the basis for determining file design and assignment of file access keys.

SUPPORT SERVICES

In order to move in the direction of automating data analysis and database design, we have attempted to more formally integrate design tools with our systems development methodology. A series of system life cycle checkpoints involving Data Resource Management, have been developed as guidelines for Project Leaders and Systems Analysts. A small internal committee, chaired by Data Administration, is currently in the process of formalizing these checkpoints and developing documention to support them. For each checkpoint, documentation will include:

- brief description of the checkpoint
- purpose
- examples
- involvement (who is responsible, participates and reviews)
- procedure, including the level of detail
- tips and techniques

In addition, it is recognized that, at the commencement of every project, an evaluation of internal training needs should be conducted. Documentation from this Checkpoint Review Committee will be passed on to our internal training area as a basis for developing a training program.

PRODUCT EVALUATION

Without enhancement, the Predict data dictionary fails to meet many of our design related objectives. The cost of tailoring this package must be constantly weighed against the ability to provide improved support of both application staff and end user requirements. However, the close ties between Predict, ADABAS and the programming language Natural, which is utilized for nearly all new program development, provides a compelling opportunity to pull together the components of our development environment. We anticipate that our direct form of technical data dictionary support may be minimized in the future. To achieve this goal, we look forward to more powerful and flexible releases of the Predict data dictionary as well as the availability of improved mainframe and personal computer based design tools which ideally, will interface with the data dictionary.

III. GEORGIA INSTITUTE OF TECHNOLOGY - AN IMPLEMENTATION OF WORKSHOP 204

INTRODUCTION

The Georgia Institute of Technology is a single-campus, state assisted university located in Atlanta, Georgia. Georgia Tech was founded in 1885 and is a unit of the University System of Georgia. The institution has an enrollment of over 11,000 students in architecture, engineering, management and the sciences. The undergraduate enrollment is approximately 8,500 and the graduate student enrollment is approximately 2,500. Georgia Tech ranks first among public universities in engineering research and development expenditures.

COMPUTING ENVIRONMENT

Data processing software support for administrative users is provided through the Department of Information Systems and Applications (ISA). Computer operations support is supplied by the Office of Computing Services (OCS). The campus is served by GTNET, an optical fiber network providing access to all computers. There are a number of mainframes available, including:

1. Cyber 180-810 - 16 megabytes of memory and 1.55 gigabytes of disk storage - Plato, CAE/CAD.
2. Cyber 180-830 - 16 megabytes of memory and 3.12 gigabytes of disk storage - CAE/CAD.
3. Cyber 180-855 - 16 megabytes of memory and 15.88 gigabytes of disk storage - Administration.
4. Cyber 180-855 - 64 megabytes of memory - Academic/Student Usage - NOS operating system.
5. Cyber 180-990 - 32 megabytes of memory and 24.6 gigabytes of disk storage - Academic and Research - NOS-VE operating system.
6. IBM 4381-R14 - 32 megabytes of memory and 45 gigabytes of disk storage - Administrative and General Academic - MVS operating system.
7. IBM 4341 - 16 megabytes of memory and 7.5 gigabytes of disk storage - CAD/CAM.

Most administrative student related computing is handled by Cyber 855 using the NOS operating system and DMS-170 Database Management System.

Many administrative accounting functions are handled by a Cyber 855. MSA General Ledger, Accounts Payable and Budgetary Control packages and Information Associates Alumni Development System are resident on the IBM 4381. The Model 204 Database Management System, under which a vehicle registration and citation processing system has been developed, as well as several small applications supplementing the MSA packages, runs on the 4381. Printing is handled by Xerox 9700 and 8700 laser printers, a high speed Cyber impact printer and distributed line printers.

WORKSHOP/204, MODEL 204 DATABASE MANAGEMENT SYSTEM

Descriptions of the product:

WORKSHOP/204 is a collection of integrated tools designed to facilitate the development of full-scale applications in a MODEL 204 environment. MODEL 204 is the current, commercial version, of what

Computer Corporation of America called a "software system" when it was developed as an information storage and retrieval system in 1967. The name is derived from the term data model since MODEL 101 was one of the first implementations of an inverted data model. Initial development was funded by Bell Labs, which sought an advanced data model for rapid access to large online databases. The MODEL 100 series which included MODEL 103, an interactive system under DOS, and MODEL 104, an interactive system under OS were not actively marketed, although the first sale was to the University of Illinois in 1969. In 1971, the product was significantly enhanced, renamed MODEL 204, and the first sale was made to the Department of Defense.

MODEL 204 was developed specifically for an integrated, online database environment. An online, interactive System Command Language permits database structures to be created and modified dynamically. User Language is a complete database application development tool which truly can be used by both data processing and nondata processing personnel. The system's Resource Management Facilities provide the ability to dynamically monitor and adjust MODEL 204's performance. The database structure ensures data independence and maximum flexibility. The System Command Language, User Language and Resource Management Facility are all native to the MODEL 204 nucleus. In addition, the MODEL 204 nucleus has direct interfaces to IBM's teleprocessing access methods: VTAM, TCAM and BTAM, which means less work in building an interactive application.

Responding to the vicissitudes of commercial competition, CCA acquired and developed a number of products to assist in system development. DICTIONARY/204, PAINTER/204, ACCESS/204 and PC/204 have been available since 1984. Several of these products and others have been brought together in WORKSHOP/204 - a product which, as advertised, integrates a collection of tools designed to facilitate the development of applications in a MODEL 204 environment. It has been available since early 1986. WORKSHOP/204 offers facilities for:

- Defining an application subsystem
- Defining and prototyping databases and views
- Generating screens and procedures to manipulate data in a view
- "Painting" screens
- Editing User Language code
- Documenting applications
- Creating test data
- Testing

Each WORKSHOP facility automatically documents its results in the dictionary. Programmers may invoke DICTIONARY/204's Documentation facility through WORKSHOP to augment the system controlled dictionary data with their own descriptions. Subsystem Management: The subsystem management facility allows the developer to define a collection of User Language procedures to form a production application requiring minimal end user knowledge of MODEL 204. The developer enters information about the subsystem: files, procedures, error handling and security. The facility provides the driver and maintains its own error handling and security. Subsystems improve performance by saving and reloading compiled procedures defined to the facility as "precompilable".

File Management: Database definition is accomplished through the file management facility. The user enters information about file characteristics, field attributes, record layouts, and field groups. Based on information provided, the file is sized. Changes may be executed immediately or in a delayed batch mode. The dictionary entries and the MODEL 204 files they describe are synchronized.

View Definition: Views are collections of logically related fields defined by the user from file definitions. View definitions specify the records and fields to be retrieved, how the data is to be displayed, display names or column headers, convenient width to be used and may include validation criteria. Different views may be relationally joined based on common field values to form a composite view. Views are used by the Screen and Action Generator, and the Query/Update facility. Views are also used by the query/report generator (ACCESS/204), and PC204, which permits retrieval, updating and data transfer between mainframe and personal computer, without having to write programs.
Query/Update: This facility is a prototyping tool for developing MODEL 204 applications. Its use enables one to create, modify, query, and update views of data without actual file creation or programming, using a system-provided file, or to perform system prototyping using an existing MODEL 204 database. It also provides a means of populating a file with test data.

Screen and Action Generator: Using a previously defined view, this facility generates a screen and "action" procedures which use the screen to manipulate data. The action supports querying, updating, displaying, and deleting of data. The generated procedures can be modified using Procedure Editor. The screens can be modified using Screen Painter. Screens and procedures generated may be used as building blocks of applications.

Screen Painter: This facility is used to create and modify screens. The user "paints" the screen, then specifies screen item attributes. Screen Painter generates the User Language code which defines the screens described in this way.

Procedure Editor: The facility enables the user to define procedures and to edit User Language code with the full-screen editor. It supports specifying characteristics of the editing sessions, such as mixed case or upper case and maintenance of aspects of the procedure definition, such as the aliases and the procedure security class.

Documentation: The user may enter descriptive data to dictionary entries of any entity type. It is useful for expanding information stored with system-generated data and for adding data that is not system-controlled.

Single-Step Test: Using this facility, it is possible to test applications subsystems by stepping through User Language procedures with several options available between each step. The name of the next procedure to be executed may be viewed and changed, global variables may be viewed and changed, any procedure may be edited, a temporary request may be run, runtime statistics for each procedure may be displayed.

As noted earlier, WORKSHOP/204, in addition to automatic updating of the dictionary, provides access to the facilities of DICTIONARY/204, the online interface to MODEL 204's dictionary.

SPECIFIC USES OF THE PRODUCT

As background for a discussion of Georgia Tech's use of MODEL 204 and of our experience in using WORKSHOP/204, it should be noted that our acquisition of a database management system for use on the IBM 4381 was a part of a long range plan for comprehensive institutional data management which included moving all administrative systems from the CYBERs to the IBM 4381. Progress in implementing that plan has been much slower than we orginally hoped it would be. We have been now for some time in a process of intense re-evaluation of existing systems, particularly in the area of the institution's business administration. The policy of the institution remains, however, to purchase package software if adequate products are available. In-house systems development is limited to applications for which no satisfactory commercial product exists. That custom work which is done is primarily on small ancillary sytems.

MODEL 204 was installed at Georgia Tech in November of 1985. The initial system installed included PAINTER, DICTIONARY, ACCESS/204 and Subsystem, the application subsystem management facility. Our use of PAINTER, DICTIONARY and Subsystem has been extensive. WORKSHOP, which incorporates these and the other facilities described was not released until early 1986 and was installed at Tech in November 1986.

The applications developed under MODEL 204 include a campus vehicle registration and parking system, inquiry to combined purchase order, invoice and check data, an accounts payable document tracking system, an interim alumni development system and a general ledger/property control interface.

PRODUCT INTEGRATION IN THE DESIGN LIFE CYCLE

The vehicle registration portion of a proposed campus parking system was chosen as a pilot project to be implemented on the system. Although design work for such a system had been done earlier, a considerable amount of time was spent working toward a data model in third normal form.

It's only fair to the vendor, CCA, and to the product, to emphasize that my comments in relation to our use of products now incorporated in WORKSHOP/204 describe our experience with earlier versions of them. While the names are the same, access to them is improved and the specific problems we encountered have been resolved.

Files, records, fields and procedures were identified through DICTIONARY - an incredibly laborious task at the time. To enter, or even accept the default attributes for a field, for example, it was necessary to progress through no less than six screens - and woe betide the fumble-fingered person who made a mistake - it was impossible to return to a previous screen in the sequence. It was necessary to progress to the end, then re-enter the function (change a entry) to correct the error. The motivation for using DICTIONARY, however, was strong - not only was there a desire to use the facets of this product we had, but DICTIONARY provided the "Database Interface" function - which sized the file and produced the file parameters and field definition statements to be used in creating a new MODEL 204 file. This facility, of course, made use of the file, record and field definition entered in the DICTIONARY. So, to the inexperienced database manager, the drudgery of dictionary entry seemed a small price to pay for some built-in "professional" assistance in file creation.

In addition, a long-term goal of our organization, rich in the accumulated product of more than 25 years of student record and administrative data processing programming, was to define the "institutional data" in an online dictionary. This project offered an opportunity to display the potential benefits in making use of such a facility.

The ability to add user-defined entities to the dictionary is an extremely useful feature. We made use of it to add further documentation, such as source of data, use, coding, format, initial content, editing, retention period and authority, which included manager, owner, custodian and user identification. PAINTER was also extensively used in development of the systems described. It's far easier to "paint" a screen, modify and re-modify it until it meets approval, than it is to code statements, test, then code again. PAINTER provides a default set of screen attributes or allows attributes to be defined by the designer. Since we use color monitors, this was a feature pleasing to some who used the product. We experienced a high level of frustration at times due to inherent product problems (inability to correctly deal with a many-item screen, occasional gratuitous duplicate entries for screen items in the metadata file, for example) and due to lack of knowledge about relation of the product to some "system" files (the wrath of a programmer who has spent an hour or more designing a screen and laboriously defining attributes only to lose it all because a temporary file is full is a sight to behold).

EVALUATION OF THE PRODUCT FOR PURPOSES USED

Despite problems with both products during the course of developing the systems described, they surely contributed to productivity. Each of the systems described was developed by a different person - each person working in a MODEL 204 environment for the first time (one in an IBM environment for the first time). The interval of time from assignment to release for production use in every case included the "What's M204, what's User Language" period, system design, file design, screen design and coding. The fact that the simplest systems were up and running in 3 weeks, the more complex in four to eight weeks, speaks well for the useability of the products - and for the capabilities of our staff.

WORKSHOP/204 which incorporates products with which we are familiar, does improve ease of use of DICTIONARY and PAINTER. The other facilities provided, particularly the prototyping capability offered and the screen and action generator, should prove extremely useful.

File and field definition, which is a function of DICTIONARY/204, is a much smoother and more efficient process in the version incorporated in WORKSHOP. Field attributes, for example, may be defined on one screen, rather than the previous laborious process of moving through six screens for each individual field.

PAINTER is more reliable. As with all the WORKSHOP products, it's now possible to remain in one of the facilities, moving forward and back, until satisfied with the results before completing the function. Previously, once begun, the apparent assumption was that the user would progress in an orderly fashion from start to finish of any function - little recognition of the all too frequent failings of most us which cause us to benefit from the opportunity to regroup and fix the oversight.

FUTURE PLANS FOR THE USE OF AUTOMATED DESIGN TOOLS

We plan to use WORKSHOP/204 facilities in the design and implementation of future administrative data processing support systems. We will make fuller use of prototyping because our limited experience proves its an invaluable tool in working with users to define the real problem. Use of the WORKSHOP facilities for data definition, screen design and procedure coding has the overarching benefit of forcing a level, and certainly an immediacy, of documentation not previously achieved.

Our experience after a recent series of in-house training sessions also indicates that WORKSHOP moves an inexperienced staff member much more quickly into productive participation in the development cycle. In the world of database design, for example, or at least in our world, there are myriad details to be considered in file design and field description - other than the familiar "what type, what size" situation. Being prompted to consider those details produces a better end-result more quickly.

SUMMARY

Does WORKSHOP/204 provide "paradise or promises"? In Milton's words "The mind is its own place, and in itself - Can make a heaven of Hell, a hell of Heaven". In the minds of those who need to launch inexperienced staff members into rapid productivity in an unfamiliar system - and who wish to maintain a degree of documentation, extracted from those staff members only against their will, it comes close to providing a paradise. To those who have, by whatever means, struggled through a learning phase and achieved a degree of competence in dealing with the database and development under it, WORKSHOP/204 is one of those "user friendly" systems we're all familiar with - when you know what you want to do and how to do it, having to pass through voluminous numbers of optional question/answer items tries the patience of the most saintly. However, even the experienced person, committed to the principle of at least minimal documentation, will welcome the automatic dictionary update which WORKSHOP/204 provides. SCREENGEN, the applications screen and code generator, while perhaps most useful to newer users, also offers relief from basic design and coding to veterans.

The product is a good one. It is useful - it delivers much of what it promises - particularly if use is instituted at the outset of moving to a MODEL 204 database management system environment.

IV. GREENVILLE COLLEGE - AN IMPLEMENTATION OF EXCELERATOR

INTRODUCTION

Greenville College has had a computer since 1978 and has developed all of the administrative software systems using College personnel. During school year 1985-86, a decision was made to upgrade the computer hardware and to investigate different software systems. Several different software vendor's systems were evaluated and compared by the different functional offices of the College. A decision was made to upgrade only the hardware using the same vendor that was already being used by the College. A Data General MV8000-II was ordered to be installed during the summer of 1986. This decision was based on several factors:

1) Several of the functional offices were very happy with the internally developed software and saw no improvement of their information needs by changing to some other vendor's software.

2) Data General's academic software program included software which would significately improve the administrative and academic uses of the computer on the campus.

3) This would be the easiest change from one computer to another. All the data bases were dumped to tape and rebuilt

on the new computer and the program sources were dumped to tape, loaded on the new computer and recompiled.

Part of the Data General software package included some components of automated system design tools. These include Data Dictionary, a Screen Generator, a Program Generator and a Source Management System. Each of these components are seperate pieces of software and we found them very weak in the areas of documentation, ease of use, user friendliness and linkage to each other.

After several months of use and evaluation we determined that these components of automated systems design tools were not sufficient to do automated system design and implementation. We then decided to purchase an IBM PC/AT and also purchase the software package called Excelerator. The IBM PC/AT was purchased to implement a network with the other IBM PC computers which were already on campus, mostly in a computer science laboratory. Excelerator is one of several CASE tools which runs on the IBM PC/AT and Excelerator was choosen because of previous experience in using the product. We knew of Excelerator's capabilities and that our internal documentation would greatly improved.

USES OF THE PRODUCT

The Excelerator product was first used in the re-development of an information system for the Admissions Office of the College. This system was completely designed by using Excelerator. When the design phase of the Admissions Systems was nearing completion, we decided to enter the complete data dictionary of all of the administrative systems for the campus into Excelerator's repository. Additionally, in several major maintenance projects we have used Excelerator to develop better documentation from which the users have a better understanding as to how the changes will effect other processes and how the changes will be implemented.

We are currently using Excelerator in all parts of our system development life cycle including new systems development and systems maintenance. During the summer of 1987 we changed the method of charging students. Previously we would wait until the last add/drop cut-off day and then charge all students their charges and apply some of the Financial Aid. We changed to a system of charging at the time of the enrollment line completion.

Several functional areas of the College were involved but very few knew how the data intregrated to create a student bill. With the assistance of Excelerator we were able to create documentation which clearly defined and explained how these processes were performed.

EXTENDED USES OF THE PRODUCT

Excelerator is linked with WordPerfect and with Harvard Total Project Manager. This gives the user of Excelerator the ability to move to the other software products without returning to the operating system. Data files can be transported from Excelerator to WordPerfect. Data Flow Diagrams, prototyping reports and screens, data stores, entity list, structure diagram are a few of the pieces of documentation which Excelerator can generate. The pieces of documentation from Excelerator and documentation from both Harvard Total Project Manager and WordPerfect help us make better presentations to users and give both users and the designers a better understanding of the information requirements of the different systems being developed.

Excelerator is also being used in course work assignments in a systems design class which is a part of the computer science major offered at Greenville College. Members of this course must design a system of some kind and several members of the course select projects which will become a part of the administrative system of the college. Some of systems which have been developed using Excelerator include:

1) College Work Study Accounting System
2) Purchase Order Entry
3) Encumberence Reporting

FUTURE USES OF THE PRODUCT

We have decided to use Excelerator as a repository for our corporate data dictionary. We have loaded information about all of the financial/accounting functional information systems elements and all of the student information systems elements into the product. There are still other areas of out information system which need to be loaded into Excelerator. We plan to do all future system development using the Excelerator product and feel that this would give us a better way to manage our corporate data dictionary. We also envision the possibility that we may change the vendor of our main computer or even add mulitple computer vendors. We feel that we can more easily move our data from our current software to other software, another hardware vendor or even add multiple computer vendors and still be able to manage our data dictionary without converting our data dictionary to some other software/hardware format.We are uploading some information from Excelerator to out Data General MV8000-II to assist in the program development process.

REFERENCES

1. Frederick P. Brooks Jr., "No Silver Bullet," COMPUTER, April 1987, pp. 10 - 19.

2. David Stamps, "CASE: Cranking Out Productivity," Datamation, July 1, 1987, pp. 55 - 58.

3. Ibid.

4. Jan Synders, "Programming Productivity Tools: Breaking The Shackles," Infosystems, March 1987, pp. 24 - 28.

5. David Kull, "The Rough Road To Productivity," Computer Decisions, February 23, 1987, pp. 30 - 41.

6. Ibid.

7. Frederick P. Brooks Jr., "No Silver Bullet," COMPUTER, April 1987, pp. 10 - 19.

8. Ibid.

Track VII
Outstanding Applications

Coordinator:
Cheryl Munn
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Many institutions have developed exciting applications in administrative and academic computing, in personal computing, in integrated and distributed processing, and more. Papers in this track describe such imaginative and effective applications.

John C. Hufziger
University of Michigan

Reid Kaplan
Yale University

Wayland H. Winstead
Virginia Tech

IMAGE DATABASES
IN
THE UNIVERSITY

by
REID KAPLAN

Presented by
REID KAPLAN and GORDON MATHIESON

Management Information Systems
Yale University

Historically, computer database systems have been used only for applications that had easily codified and key-entered data elements, or a payback great enough to justify complicated encoding and processing. Advances in personal computers now make it possible to include complex objects or documents in databases inexpensively . Instead of relying on descriptors alone to convey information about an object, we can include an actual picture of it in a database. This image can be manipulated, stored, retrieved, and displayed by standard database management systems augmented by a few special purpose modules and assisted by a graphics board. We have found that there are as many administrative applications of image systems as there are academic ones. After discussing image system concepts, we will describe, and demonstrate, prototype systems from each area. The first will be for a Human Resources Department: an image database for tracking applications for employment. This document has much handwritten information that causes key entry to be prohibitively expensive. Also, the paper form itself is hard to find in simply indexed filing cabinets. Conversely, electronic images of the document can be scanned and retrieved quickly and cheaply. The second will be a database of archived color paintings in one of Yale's museums. This allows researchers instant access to paintings for comparative studies, stylistic analyses, and many other scholarly tasks.

I. Introduction.

In the Spring of 1986 it became apparent that essential hardware and software components of image processing and image database management systems had been created for use with personal computers and were inexpensive enough to be cost effective in many applications. Some were commercially available and the release of others was imminent. At the same time, it was also apparent that this facet of the data processing industry had only recently emerged and both the marketplace and the technology were chaotic. In essence, there were a number of different solutions looking for a problem and key elements of a solution to some specific problems did not exist. However, the potential advantages of manipulating and managing pictures in the same ways as traditional data were so obvious that Management Information Services (MIS) initiated an investigation of the technology. The way to do this was to develop prototype image databases with off-the-shelf hardware and software. Actual experimentation would graphically illuminate the issues involved as no amount of speculation or literature searches could.

From the very beginning we had a clear idea of the heart of any microcomputer-based image system, the database management system. It is essential that images be managed in the same way, with the same flexibility and with the same response to unanticipated demands, as Yale's alphanumeric data. It is also essential that image database management systems be compatible with those that manage the university's central data resources.

It was also clear that we had to select objects that were visually demanding as well as informationally complex. A simple task would not tell us much. We were fortunate to find two organizations that had suitable objects, had text databases describing the objects, and had enough interest to cooperate with us: the British Art Center (BAC) and the Department of American Decorative Arts of the Yale University Art Gallery. We created integrated text and and color video image databases of a subset of the paintings in the former and of three dimensional silver artifacts in the latter.

In order to investigate scanner technology and pursue the elusive grail of the paperless office, we coupled together an easy to use PC database management system and an image scanner. The application we chose to develop was for the Human Resources Department: a system for tracking applications for employment.

This report describes, in general terms, what we have learned during the course of creating these prototypes and the current status and potential applications of this technology.

II. 1. The structure and content of digital images.

An image on the monitor screen of a personal computer can be considered to be the analogue of a table: a rectangular array of cells called picture elements, pixels for short. If the notion of an image as a table is extended in one conceptual dimension, the color of each pixel can be integrated into an overall image description. Imagine the bits that encode the color of the image to be orthogonal to the plane of the image, sticking out of it, if you will. We can now talk about "bit planes", layers of bits in a rectangular array. The larger the size of the code representing the color, the greater is the image's fidelity to the original because more discrete colors can be represented. For our purposes, we can consider gray levels of monochrome images to be colors, too.

What is a color that ye may know it? For the purposes of computer displays, a color is a number that differs by a single bit from all other numbers used in an encoding scheme. That single bit will cause a primary color component to be increased or decreased by one quantum or level. In the most commonly used additive color model, red, green, and blue are the primary components that are varied to produce a final color. Contrary to common belief, it is not possible for combinations of three primary colors to match all colors, nor must primary colors be red, green and blue. However, it turns out that these three match the largest numbers of colors and so are most efficient (Sears and Zemansky 1960, 886-888). An example will make clear how colors might be encoded. In the scheme used with AT&T's Truevison Advanced Raster Graphics Adapter (TARGA) 16, red, green, and blue are each represented by a 5 bit number; 00000 00000 00000 is black, and 11111 11111 11111 is white. Pure bright red is 11111 00000 00000; lightest pink is 11111 11110 11110. There are 32 possible levels of each primary color and, therefore 32 cubed or 32k colors total. Grays are indicated by three identical 5 bit groups. Obviously, if only grays were being displayed, the redundancy inherent in this encoding would be grossly wasteful of storage. One would choose, therefore, to employ a single number to indicate each level.

How many colors are enough? It depends on what you are trying to do and it depends on the interaction of the human eye with the display. It has been reported in journals, unfortunately without attribution, that psychovisual studies have shown that a human can distinguish between 16 million different distinct colors but can only identify about 50 different gray levels. Our own studies have shown that the ability to distinguish between two adjacent colors is dependent on which components are changed. It is not only that the eye is most sensitive in the green portion of the spectrum, there is also some sort of weighted averaging going on. If a majority component of a color is changed by one unit, the result is much more apparent than if a low level component is changed. To continue the TARGA 16 scheme with the use of decimal equivalents, suppose that the RGB components of a color are 31 15 15: a tomato red. A change to 31 14 15 is just barely noticeable even though the eye is most sensitive to green. A change to 30 15 15, however, is very noticeable.

In addition to color content of an image, subject matter makes a great difference in perceived image quality. For instance, humans are extraordinarily talented at recognizing human faces. Many fewer colors are required for a picture of a face to be rated highly. Thus, personnel or security applications of image systems can get away with lower performance hardware than more general systems. There are also situations where a large number of colors is not desirable. In an application where the image is schematic and not intended to reflect reality, too many colors can be distracting. Standard presentation graphics, maps, or CAD images use color for information encoding, by and large. In such cases,the image is very confusing if it is shown with more than about 16 colors. However, if the image is of an actual object or scene, or a simulated object is intended to appear real, 32,000 colors might be barely adequate.

The eye's ability to discern color variation is not the only reason for wanting many colors in a natural image. Color resolution can, to a certain extent, create an illusion of high spatial resolution. This is why the woefully inadequate color TV specification in this country has not sparked viewer rebellion. The way this happens is by an effect called antialiasing. We have all seen the stairstep pattern that results at a diagonal border between areas of two different colors. It is sometimes called "jaggies" and it is an artifact of raster scanning on low resolution devices. The technical term for this is aliasing. The appearance of aliasing can be mitigated by inserting pixels of intermediate colors between the adjoining areas, but it requires that many colors be available for smooth transitions to occur. The TARGA boards have clearly demonstrated the value of a large number of colors. They are nominally 512 x 512 pixels; only 482 are visible in the vertical dimension. This is no better than many EGA boards on the market, but, with 32k to 16m colors available, the images they display are vastly superior. Even the new VGA, with 256 colors, displays images that look like crude posters in comparison. Antialiasing can work with gray levels, too. Another AT&T group has developed a system for teleconferencing that uses a scanner capable of detecting 16 gray levels. The scanned image is displayed on standard EGA boards with a resolution equivalent to 80 dots per inch (dpi). This is much below the 300 dpi that has become the desktop publishing minimum standard, but the images are much more realistic and legible when displayed on the monitor screen with anti-aliasing.

II. 2. Scanning and video image capture.

There are, at the moment, two primary ways of getting images from the real world into a computer: scanning them with a charge-coupled device (CCD) array or capturing a frame from a video camera. The electrical signals representing the image are converted to numbers, digitized, by a special processor board in a personal computer.

Scanners are primarily intended for flat objects, but that is a matter of the design of the optical subsystem; at least one device has a depth of field of several inches. Scanners have the virtues that they are inexpensive, optimized for paper handling, and, at the moment, have higher spatial resolution than video cameras. They are comparatively slow however; scanning a full page takes about 14 seconds. Video cameras are more versatile in that they can take pictures of any sort of object or scene and the image can be modified during capture. They have highly developed color reproduction mechanisms and can operate swiftly; an image can be captured in 1/30 of a second. As in photography, lighting and color calibration are of crucial importance.

Image capture is the most expensive and technologically limited step in the process. It is expensive because it is labor intensive and because cameras with capabilities at or in excess of current broadcast standards do not benefit from the economies of scale that consumer electronics like personal computers enjoy. It is technologically limited because there have been few incentives to develop devices with capabilities beyond the current broadcast standards. Nevertheless, it is possible to capture images for about the same cost per image as photography because there are no consumables and the labor costs in either case swamp the capital costs.

II. 3. Image editing and enhancement.

After digitization, the image is invariably manipulated in some way. Even the simplest application will require elimination of distracting backgrounds, centering, sizing, rotating, and the like. More complex applications will demand the sort of processing that, until now, has been used only by television and movie studios. Examples are color alterations and the integration of text and original graphics with the image.

If the central goal of the application is image analysis or enhancement, image manipulation can be extremely involved and the results can border on the miraculous. We have seen most of this technology exercised on the fascinating pictures sent back from space by the Voyager vehicles. It is possible to filter out salt and pepper noise - the equivalent of snow on the home TV screen, restore definition, accentuate features such as edges, expand the dynamic range of the picture, and so forth. Image processing programs that do all these things are routinely available for PC's and cost about as much as 2 to 4 copies of a full function word processor.

II. 4. Image storage and data compression.

Images are file hogs. In the worst case, a full page, 16 gray level image takes around 100k. The smallest half page, 4 level image we have seen is around 23k. Color images take about 490k for an uncompressed, 32k color, 512x512 picture. No single magnetic disk at the DOS limit of 32 mb (320 pages) can hold enough images for a practical database. However, with the steady improvement of magnetic disks, the emergence of new storage devices, and the judicious use of compression techniques, practical, useful systems can result.

At the moment, we are using standard magnetic disks for storage. An IBM PC-AT with a 20 mb hard disk and an external cartridge disk drive with 40 mb immediately accessible, can store about 240 full screen color or 1200 black and white pictures. As the cartridges are removable, the total potential size of any database is infinite. Currently, there are commonly available personal computers with 100 to 130 megabyte disks. If history is any guide, the capacity of magnetic disks attached to PC's will quadruple in capacity and halve in cost per byte in the next three years. This means that image databases of 1000 immediately accessible color or 5000 black and white pictures stored on magnetic disks will be commonly affordable. In that same time, a new technology should mature. This is fortunate as many applications will require larger storage than magnetic media can provide.

Optical disks, capable of storing between 200 mb and 1000 mb on a single disk are available now, and will be routinely supported by PC system software. They have one important technical limitation; the data can only be written once. Thus, they are restricted to applications with static databases or enough users to justify creating new disks periodically. These devices are called WORM drives and CD ROM. WORM stands for Write Once Read Many and CD ROM for Compact Disk Read Only Memory. Both use optical technology to achieve an extraordinarily high data packing density. A WORM cartridge is written by the physical ablation of spots by a high energy laser and read by differential reflection of light from those spots. Because writing involves irreversible physical changes, an update consists of rewriting the affected portions and ignoring the old version. However, the important point is that the writing mechanism is included in the drive and the user can initiate the writing and rewriting locally. A CD, although superficially similar in that information is contained in laser detectable pits, must be mastered and pressed in a plant, a complicated and expensive process. Moreover, it really is a read only medium. If updating is required, a new disk must be mastered and a pressing run initiated. Obviously, this is cost effective only for static, high volume items.

How one stores one's images depends on the size of the image database. As described earlier, images of moderate quality are quite large. However, there are compression techniques that reduce the size of image files. Depending on the image content, an image file can be compressed to between 60% and 10% of its original size without loss of information. Compression techniques can be classified as destructive or nondestructive, and the latter can be divided into methods that take advantage of an image's raster structure and methods that can be applied to any type of data.

Destructive compression techniques are usually applied to an image's colors; rarely are images compressed in the spatial domain. The reason is that an image's spatial resolution is usually fixed to be that of the graphic adapter that will display it. In the simplest case, an image is posterized. That can be accomplished simply by truncating or averaging the color code. The result looks very much like a poster with large regions of single colors bounded by abrupt changes. There are, however, smarter schemes that will sample the image and select an optimal reduced palette. Some of these schemes operate not on individual pixels but on tiles of, say, 16 pixels. There exists a proprietary processor add-in board that can do this swiftly in hardware and allows the user to select the degree of destruction. The results for some images are nearly indistinguishable from the original.

Of the nondestructive compression schemes, the simplest is run-length encoding. This takes advantage of the fact that an image is made up of lines and often these lines contain sequences, or runs, of identical color. So, an image can be stored as a series of doubles; one number is the color of the run and the other is the number of pixels in the run. It turns out that "natural" images, pictures of real objects, can be compressed only about 10% by this technique, although computer produced graphics are compressed anywhere from 50% to 90%. The problem with natural images is that there are subtle hue differences from pixel to pixel. For instance, an image of a white wall actually consists of small patches of blues, pinks, and various other unnameable shades. One way around this problem is to run-length compress by bit plane rather than by pixel. Of course, this is possible only with boards that have planar encoding schemes. In the CGA, blue is encoded by 0001, green by 0010, and the intermediate cyan (blue-green) by 0011. If adjacent pixels in a run were made up of these three colors in alternation, no compression could be achieved by considering them as individual pixels. But all three have the two higher order planes in common and so could be compressed by about 50% if those two planes were collapsed into two doubles.

There are several compression techniques based upon statistical analysis of image content. The original, and still popular, example of these is Huffman encoding (Huffman 1952). A first pass is made through the image data to determine the relative frequencies of colors. The most common color is encoded with the shortest code. The next most common color is encoded by the next longest code, and so on. The result is a table, called a Huffman map, of original color codes and their optimal new encodings. During the second pass through the data the new codes are assigned. To decompress the file, the Huffman map is used as a key. This is a time consuming process; on a 12 megahertz 80286 machine a 494k image compresses in 12 seconds to 26% of its initial size and decompression takes 9 seconds. To increase speed, boards have been developed to perform the process in hardware and to eliminate the analysis step. They depend on predetermined maps determined by examination of a large number of "typical" documents encountered in fax transmissions. This map has been dubbed Fax Group 3. It works fairly well if the images conform to Group 3 statistics, but not all do. Clearly this only applies to gray level images.

II. 5. Image display and output.

After they are stored, and retrieved for some specific purpose, images must be displayed.

The immediate, and many times, only, display device is a high quality color monitor controlled by a display adapter. The monitor is largely a passive device; the image is stored and manipulated in the adapter and the adapter determines its resolution. The standard PC Color Graphics Adapter has 640 pixels horizontally and 200 vertically when it is displaying 2 colors; the IBM EGA is 640 x 350 and Extended EGA's and the new VGA are 640 x 480 with anywhere from 4 to 256 colors displayable at the same time. Except for monochrome document retrieval applications, this is barely adequate resolution. Most uses will require either more colors or more pixels. For instance, professional Computer Aided Design (CAD) or medical diagnostic images have a typical lower limit of 1024 x 768 pixels but they require only 16 to 256 colors. For displaying real-world objects, a reasonable device is the TARGA 16 with 512 x 512 x 32768 colors. For somewhat more money, there is a new generation of adapters with programmable resolutions of up to 4k x 4k pixels with up to 16 million colors. These adapters are equipped with onboard graphic processors that make image manipulation quick and easy. Only a short time ago, these capacities were available only on mainframe or supermini systems that cost an order of magnitude more.

For comparison, a home TV screen in the United States displays about 480 rows and about 350 columns. This is not really very good, but it is made acceptable by the nearly infinite number of colors displayable in each pixel. The all-time champ for combined spatial and color resolution is photographic film. A 35 mm. color slide, normally thought of as small, contains about 6 million pixels or the equivalent of 2958 rows and 2028 columns. Moreover, each pixel can contain a nearly infinite range of colors.

The monitors that display images, and perhaps standard text as well, are of two sorts: digital RGB and analog RGB. The former is sometimes called RGBI, for Red Green Blue Intensity, or TTL for the kind of transistor logic that is often used. These monitors are designed to display only a few colors (or gray levels); the PC standard CGA displays up to 16. These colors are specified by a four bit code that determines which of the 3 colors is on or off and if the electron beam is bright or dim (Norton, P. 1985, 71-77). These monitors can be quite inexpensive since so little is expected of them, but the colors of images are hardly natural. Having said this, it also must be said that the limitations of 16 gray levels are much less apparent than the limitations of 16 "real" colors. This has to do with the inability of the human eye to discriminate between gray levels as well as it does between hues. In addition, the kinds of monochrome images that are usually displayed do not have a very wide dynamic range. Analog RGB monitors can potentially display an infinite number of colors because the amplitude of analog signals is infinitely variable. As a practical matter, the number of colors actually displayed is limited by the amount of display memory available for color information. Multisync or multiscan monitors typically have the ability to display analog signals as do multipurpose monitors such as the Sony PVM-1271Q and the new generation of monitors for the IBM PS/2.

Many applications demand display in other media. Cameras that transfer digital images to 35 mm. transparencies exist. Our experimentation with them show that they do the job very well. However, this type of device, like a high quality TV camera, is best shared by many users. It is not likely that a single user could keep it busy or would wish to spend the $3000 to $5000 it costs.

We have experimented with transferring color images to paper via special thermal and ink jet printers. This technology is still in a very primitive state and the technical problems are formidable. No printer we know of is currently a true production device; there are problems keeping the printers operating optimally, images take 5 to 10 minutes to print, and the colors, especially those produced by thermal transfer, are unsaturated. For the present, hard copy devices are best used to produce proofs before a final copy on film. Of course, the image may be printed in standard ways from the film copy.

II. 6. Image database management systems.

Perhaps it is because of our background, but there was never any doubt that database management systems (dbms) must be used for images. An unorganized collection of images, even if computerized, is like a shoebox full of snapshots. Try to find the one of Aunt Bertha at the beach in 1927. Fortunately, database management systems that integrate images with descriptive and categorical text now exist. Unfortunately, there seem to be only two sorts: fairly simple but fairly inflexible dbms' tacked on to a graphic front end and full function, fixed field, dbms' loosely bolted to image capture and display facilities. A common denominator of these products seems to be that they were designed in a vacuum with no regard for the user. We have tried to influence the design and facilities of these programs, but, with one notable exception, we have been largely ignored. However, we have great faith in market forces; as soon as the demand for image systems makes itself felt, the software houses will come to heel.

The first thing a system designer must realize is that an image can reside anywhere; it need not be on the same storage device as the programs that manage it or the text data that describe it. Thus, a practical image database management system must keep track of the volumes and drives that contain the image files. Most PC dbms products do not now have the capability to span volumes or know which drives the volumes are mounted on. Nonetheless, it is a problem that has long been solved in principal, as mainframe users will instantly realize.

In addition to physical structural flexibility, an image database must have logical structural flexibility. For instance, the capability to have more than one image per record is a necessity, although many current PC products do not allow this.

Apart from the need for extreme storage flexibility, image databases have the same functional requirements for their management as standard databases. An image database schema will be identical to one that contains no pictures except that the alphameric fields will be limited to a minimal set of descriptors. After all, the image contains most of the information in such a database and only those descriptors required for retrieval need be entered. Also, the familiar database functions of add, update, and delete all have image analogues. These analogues will differ on two counts from the ones we are all familiar with: they must cope with two-dimensional objects of variable size.

Addition of images to a database requires complex editing facilities and clever linking to text descriptors. In the standard dbms there are certain editing functions provided by hardware and software that are considered essential when entering text, such as deletion, insertion, overstriking of individual characters, and placement of individual characters within the field. These are simple because of the orderly, linear, left to right, top to bottom structure of western scripts. In addition, certain arbitrary but reasonable limitations are placed on the amount of text that may be entered. Two dimensional data are much more difficult to handle because of the transformations possible in the plane and because there are far fewer conventions that constrain those transformations. It is also true that there is a much less clear cut dividing line between record entry and record modification. For instance, a retailer may wish to provide its dealers with a database of parts for inventory and quick access. Each individual image "page" may actually consist of parts of several primary images: a picture of the part, text attributes such as part number, location in the storage area, and a diagram of where the part fits in the assembly. If the user has to first paste these up by hand in an art department, there is much less incentive to use electronic retrieval as a cost saving measure. An image editor should allow individual sub-images to be captured and then modified to form the final image ready for retrieval.

The simplest form of image editing is cropping. Except for certain archival applications oriented towards the 8 1/2 x 11 page, it is not acceptable to force the inclusion of an entire image as captured. Real estate, physical security, and inventory applications come readily to mind as requiring cropped images. Cropping is easy to do, is included in almost every database product, and, moreover, it has an important technical benefit: it saves image memory buffer and disk storage space.

To be really useful, an editor must include the three two-dimensional linear transformations that preserve shape: translation, rotation, and scaling. Most image database products have a translation feature, more or less well implemented. It allows the composition of a compound document and is rather easy to do. Some, but not all, image editors allow rotation, and those that do often restrict the angle to 90 degree increments. It is easy to program in principle, but rotations in other than 90 degree increments produce aliasing artifacts that are difficult to minimize. In most applications, rotation is used for correcting small misalignments in the captured image and, therefore it is essential that this function be well implemented. Scaling is the magnification or reduction of an image or part of an image. All image database products have this capability. Reduction is easy, but magnification is not. The reason is that the original was scanned at an absolute resolution floor; there is no more detail to see. Therefore, either some sort of interpolation and smoothing must be added during magnification or the application must be able to tolerate the more obvious appearance of pixels.

A third class of image editing is annotation. This can take two forms: locator controlled, or keyboard actuated. This feature has some memory overhead due to mouse drivers and/or font storage, although, it is easy to do. Some, but not all, products can do this.

In addition to the simple editing functions discussed above, it is possible with some systems to provide full function image editing through extensive "paint" packages such as TIPS, PC Paintbrush, or Dr. Halo. This can be done if the dbms supplies the user with the names of scanned image files. The user can scan, store images temporarily, run a report that lists the file name assigned by the dbms with an explanatory or identifying field entered by the user, and exit the dbms. Then the user invokes the paint package and accesses, edits, and resaves the images. This process runs the risk that the user will save the edited image with a name unknown to the dbms, but an astute user should be able to maintain data integrity with a little effort.

Updating an image can mean replacing it totally or modifying the existing image in some fashion. In both cases it is nearly certain that the size of the new image will be different from the old. The database manager must allocate and reclaim storage space in an intelligent manner. Otherwise, massive inefficiencies can result. If the image is modified by the user, the comments made previously about editing apply here. Linkages to descriptors must also be maintained.

Deletion is relatively simple if two principles are applied. First, since descriptive data and images may be loosely coupled, it is important to ensure deletion of both elements. One can not exist without the other. Second, if the storage medium is rewritable, the large space occupied by the image should be reclaimed immediately. When images are measured in megabytes, waiting to reorganize a file could prove fatal.

III. Document retrieval: the Employment Application Tracking System.

Document retrieval is a natural candidate for image database use. It is not as flashy as other uses of image technology, but the potential payoff is enormous. There are literally forests of paper, that must be referred to, in files all over the university. These documents can only be filed sequentially by single descriptors so retrieval is tedious and expensive. Often these single descriptors are the wrong ones for certain important purposes. Worse, many are misfiled and can be lost forever or cost an inordinate amount to find. The data on most of these documents are not transcribed to a computer database because they are not easily codified and key-entered or the payback is not great enough to justify complicated encoding and processing.

Putting them on microform does not help much. There is a cottage industry producing so-called Computer Aided Retrieval programs for microform, but the encoding problem still exists and even if you have a reference you must still find the microform the document is on.

A classic example of a document that is difficult to manage is the application for employment. It has much handwritten information that causes key entry to be prohibitively expensive, especially since the value of the document is transitory. In some cases, a photo of the applicant is part of the document and must be retrieved too. Currently, applications are simply filed by job type and photocopies are mailed to all departments that are hiring that category. Employment representatives are assigned to deal with broad classes of jobs, upper clerical, for instance. When a department requisitions a job search, the rep maintains a local file of responding applications and includes all the applications from the central file that are possible to find. When the job is filled, all the applications are put into the central file for about 6 months, after which they are purged. The problems with such a system are obvious.

Our prototype document retrieval system provides much more capability and flexibility while reducing the demands on the employment rep. The operator first enters a small set of descriptors about the application in a menu driven form displayed on a PC monitor. The application itself is then placed on the scanner bed and a function key pressed to scan the form. If its appearance is satisfactory, another function key is pressed to store the picture of the page. At the same time, the dbms assigns the image a unique file name and links it to the descriptor data.

The system allows for multiple pictures per document, in this case, one for each of the four pages of the application. Retrieval is performed on the descriptors and has full relational capability. For ad hoc retrieval, the operator simply enters criteria into another menu driven form on the monitor. Alternatively, a query language can be used for complex searches and reports. Those documents that satisfy the criteria can be displayed on the monitor by simply pressing still another function key. A half page fills the screen, but the entire 8 1/2 x 11 inch page is viewable by scrolling using the Page Up and Page Down keys. The user can browse back and forth from page to page or cause the page to be printed. Alternatively, the pictures of the document can be sent over phone lines to the PC of another person for viewing.

IV. Color video image database: British paintings

The many objects in Yale's galleries, museums, and collections are among the most under-utilized resources of the University. Some may be on display, and certain others may be accessible, but a very small fraction of Yale's holdings are used for teaching or research. There are a few simple reason for this. Many are not catalogued. Even if catalogued, the objects' catalogue references have very limited information content. A person selecting items for a study collection must still find and examine candidate objects for relevance to the objective. In many collections, this is not an easy task. It is also true that some desirable, even essential, objects may not be available for examination when required. Finally, when objects are located and chosen, they must be photographed for presentation or examination, for only a few sorts of objects may be removed from storage. Photographing is time-consuming, technically complex, and expensive. Moreover, a single object may undergo this process several times, making the total cost to the University very large indeed.

Among the Yale institutions addressing these issues, the British Art Center has one of the most extensive, informative, and accessible catalogues in the Computerized Index of British Art. It contains a total of some 42,000 art objects located around the world, of which the Yale holdings are an important subset. Textual descriptions of the art are managed by a flexible database management system which also directs searchers to an entry in an archive of black and white photographs. Although this system is a major step forward toward addressing the problems of speedy and inexpensive access to a complete information source, there are still some very important elements to be added before it can be used routinely for teaching and research. Pictures of the art are obviously the most important.

A user must be able to perform ad hoc requests for information, browsing through the database to find the appropriate items. In order to determine the appropriateness of the objects, they must be displayed instantaneously for immediate acceptance or rejection. At present, a user must search for a quantity of candidate objects and, armed with a lengthy report, proceed to the photo-archive proper to search for and locate the images. A copy of the black and white prints of those works that are suitable is then provided the inquirer. Further cycles of enquiries and searches might be necessary to refine the final selection. In addition, the product, a black and white print, is not often the medium of choice for a teacher. Most often, color transparencies are required for classroom display. We have been working with the BAC to investigate how we might improve their capabilities in these areas and, additionally, develop them so that the result could be transferable to other organizations on campus. MIS has captured images of a small subset of the BAC's displayed paintings using a recently developed raster graphics adapter in a personal computer. Attached to a video camera, this adapter can digitize color images of moderately high spatial and color resolution. The images are then stored, currently on magnetic media, and displayed on a special monitor also attached to the adapter. The images can be manipulated in many ways by image processing software that MIS has obtained. MIS was a test site for a version of the database management system, that is used for the index, that is able to integrate text and these images. In addition, color transparencies and color prints can be output on demand. On the basis of this study, we have also determined that other Yale organizations need, want, and can use the system; a prototype has been developed for the silver collection of the Yale University Art Gallery and the Yale Babylonian Collection has applied for a grant to create a database of images of their cuneiform tablets.

V. Summary: Application Areas, Common Requirements, and Common Problems.

We have learned that there are four generic applications for computer based image systems: 1. image databases, 2. complex illustrations for lectures or publications, 3. creative graphic art, and 4. image analysis and enhancement. Of great importance is the fact that, except for perhaps the last, there are as many specific applications in the administrative areas of the University as in the academic. We have also learned that although one of the four may be a user's primary interest, at least one, and most often two, of the other categories will be required to support it. This means that multiple or integrated software packages are required and that there is an immediate community of interest among all users. This also means that the University could effect enormous economies of scale by providing centralized image capture facilities and concerted purchasing programs.

The weakest links in the technology are the design of the database management systems and the image storage devices. These are only engineering problems, however, and are certain to be overcome, perhaps within a year. Of greater concern in the application of the technology is the acceptance of it by the end user. The people who are likely to benefit most from it are precisely those who are least technically adept and aware. The sociocultural systems that are entrenched in the private university compound this problem. Patience, communication skills, and friendly systems are essential tools in an implementer's kit.

Image systems are affordable. An entire PC based workstation, including software, is in the $10,000 to $12,000 area. The expense is in the personnel costs for image capture. But, thankfully, this is a one-time cost and is more than offset by the savings afforded by swift and certain retrieval. The cost of finding a misfiled document has been estimated to be between $25 and $50. The cost of paper shuffling is mounting. The cost-benefit ratio of wharehousing unused and unseen objects is infinite. Can we afford not to use this technology?

REFERENCES

Huffman, David A. "A Method for the Construction of Minimum Redundancy Codes," Proceedings of the I.R.E., 1952, 40, No. 9, 1098-1101.

Norton, P. Programmers Guide to the IBM PC. Bellevue: Microsoft Press, 1985.

Sears and Zemansky. College Physics. Reading: Addison Wesley, 1960.

USING INFORMATION TECHNOLOGY FOR TRAVEL MANAGEMENT AT THE UNIVERSITY OF MICHIGAN

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Over the past several years, colleges and universities have begun to develop programs to reduce the cost of travel and improve the level of service to their travelers. These programs are in response to some significant changes within the travel industry brought about by airline deregulation, increased competition among travel agencies, and the application of information technology to the travel agency's "back office" operation.

In developing these programs, one of the most important objectives is to obtain better information about travel patterns. How often do travelers go to a specific destination? When do they go and how long do they stay? Is there a significant amount of business with a particular hotel chain or car rental firm? The information that is needed to answer these and other questions is available in airline reservation systems, travel agency accounting systems, corporate charge card information systems, and institutional data bases. The challenge facing college and university travel managers is to effectively utilize information technology as a major component in a travel management program.

Using Information Technology for Travel Management
at
The University of Michigan

The Emergence of Travel Management at Colleges and Universities

Over the past several years, a series of events in the travel industry has made it advantageous for colleges and universities to develop programs to reduce the cost of travel and improve the level of service to their travelers. The first event was the deregulation of the airline industry, which resulted in increased competition between airlines and lower airfares. Lower airfares meant lower commissions to travel agents, and, in order to gain a larger market share, travel agencies became more aggressive in competing for the business traveler. By offering services designed specifically for the business traveler, agencies hoped to increase revenue. Computerization of the travel agency was another event that provided the opportunity for savings to colleges and universities. While airline reservation systems have been in use for many years, it was only recently that the back office of the travel agency was fully automated. This automation has made it possible for travel agents to provide a wide range of management reports to their business travel customers.

Another trend in the travel industry that is becoming more commonplace in colleges and universities is the use of a corporate charge card. There are two primary reasons for implementing a corporate card program. First, it can provide another means of obtaining valuable information about travel patterns to be used in negotiating discounted fares and rates. Reports that are commonly available with such programs include expenditures by industry (airlines, hotels, etc.), by vendor, and by geographic region. Second, it reduces or eliminates the need for cash travel advances; these funds can then be put to more productive use.

Travel industry experts estimate that savings of up to 40% can be achieved by implementing policies and procedures to provide better control over travel expenditures. The amount of savings obtained will depend on how liberal the existing policies are and how restrictive the new policies might be. It will also depend on the volume of travel and the particular travel patterns of an institution's travelers. Institutions that have a very decentralized travel policy can expect minimum savings of 18%-20% in air fare expenditures by concentrating their business in a single off-premise, full-service travel agency that guarantees to offer the lowest applicable airfare. Savings of 30%-40% or more can be obtained if a large percentage of air travel is between a small number of city pairs, which would make it possible to negotiate bulk fares directly with an air carrier. Savings of 10%-20% in hotel and car rental rates can be achieved by negotiating rates based on expected use.

Travel Management at The University of Michigan

Within this framework, The University of Michigan implemented a Travel Management Program in 1985 designed to reduce travel costs and improve the level of service to University travelers. This program has three major components:

- Designated Travel Agents
- University-Sponsored Charge Card
- A Coordinating Office

In selecting designated agents, the University developed a set of criteria that was used to evaluate the ability of a travel agency to provide certain guarantees and an appropriate level of service to University travelers. Designated travel agents have guaranteed that they will meet the objective of offering travelers the best available airfare given the constraints of the traveler's schedule - commonly referred to as the lowest logical airfare. Designated agencies were also required to utilize a rate desk - which provides an independent review of all University reservations to insure that the best fare was obtained. Since more than 25,000 airfares change each day, the rate desk not only reviews every reservation before it is ticketed, but also regularly reviews tickets and reservations until the date of departure. If a fare increase is pending, reservations are ticketed. If a fare decrease has occurred for tickets already issued, or if clearance is obtained for waitlisting on discounted seats, the tickets will be re-issued at the lower airfare. On a monthly basis, each designated agency submits a magnetic tape containing billing and sales data.

The University of Michigan selected American Express to provide corporate charge cards to faculty and staff. The no-fee, no-liability program currently has over 2,700 cards in distribution. Each month American Express provides magnetic tapes that are used for reporting and for controlling cards.

The Travel Services Office was established to coordinate the Travel Management Program. This office serves as a liaison with the designated agencies, American Express, and University travelers. In addition, the office has the responsibility for negotiating discounted fares and rates with airlines, hotels, and car rental firms. A newsletter, Travel Tips, is published periodically by the office to keep University travelers abreast of industry developments, new corporate agreements, and other travel-related issues.

Information Resources for Travel Management

In the mid 1970's, travel agents throughout the country began to install computerized reservation systems. Now, according to Business Travel News, over 97% of this nation's travel agents are using some type of computerized reservation system. Although this market is dominated by American Airlines' Sabre system and by United Airlines' Apollo system, there is an emergence of several new vendors offering equivalent or enhanced systems. These reservation systems enable travel agents to make bookings with most major airlines, hotels, and car rental companies. The newest and most sophisticated systems allow the agent to search for the lowest airfares automatically.

While the majority of agencies are online with a reservation system, it has only been in recent years that agencies have begun to automate their back office functions. It is estimated that 41% of the travel agents in the United States are currently making use of a partially or fully computerized back office system. Many of the back office computer systems encompass several of the agencies' office functions.

Some of the back office systems include:

- accounts receivable, payable, & general ledger functions
- business forecasting
- commission tracking
- ticket/itinerary printing
- reporting capabilities
- passenger profile functions
- agency branch communications
- word processing
- electronic phone book, calendar, & reminder list

Of the above functions, the passenger profile systems and reporting capabilities directly affect travel management at the University. Passenger profile systems allow the agencies to store a list of preferences submitted by University travelers. The profile, which contains the traveler's preferred airline, hotel chain, car rental company, seat selection criteria, frequent flier numbers, credit card numbers, and other similar information is automatically retrieved when the agent books airline tickets, reserves hotel rooms, or reserves rental cars for the University traveler. The back office reporting capabilities enable the agents to extract a client's travel information captured by the reservation system and provide it to the client either in the form of management reports or actual booking data on magnetic media.

In addition to capturing the data at the time of the booking, Travel Services is able to obtain data that is captured at the time of billing. American Express, the University's current supplier of corporate charge cards, provides Travel Services with three monthly reports. The first report is a vendor summary report listing the total number of transactions and dollar volume spent at each vendor. This report is first broken down by the type of establishment, i.e. airlines, lodging, auto rental, etc..., and then by individual vendor name. The second report is a geographic vendor summary listing the same information as the first, but is instead broken down by state and city, and then by type of establishment and individual vendor. The last report lists all airline tickets purchased with the corporate charge card. This report includes the billing price, the name of the airline, and the origin and destination on the ticket. American Express gives the University the option to receive these reports printed on a hardcopy, or to receive the data files these reports are derived from on a magnetic tape. American Express also allows their corporate clients to sign on to the American Express computer system and run these reports online or create their own queries and reports.

Each month, American Express supplies the University with a magnetic tape containing a data record for each existing University corporate cardholder and for any newly opened accounts. This tape is used to automatically update the corporate cardholder data file maintained by Travel Services. In this way, Travel Services is able to keep accurate records of any accounts that have been added, suspended, or cancelled.

The final information resources accessed by Travel Services are the University's faculty/staff database and travel voucher history data file. The faculty/staff database is used to verify employment data and produce mailing labels for mass mailings by Travel Services. The travel voucher history file is used to retrieve the staff identification numbers of all employees who have submitted travel expense reports. This was the method used for contacting the faculty and staff who do the majority of traveling at the University.

All of these resources - computerized reservation systems, travel agency back office systems, corporate charge card data systems, and University data systems - create various opportunities in which the Travel Services' management is able to analyze the University's travel patterns and gather data that can be used to negotiate discounted fares and rates.

Systems for Travel Management

In order for the University to reduce travel costs and increase the level of service for its travelers, it became necessary for Travel Services to develop a system in which travel expenditures could be captured and analyzed in a more accurate and efficient method. When the Travel Management Program began at The University of Michigan, designated travel agents provided the University with hard copy reports. Although the reports were adequate in supplying information on the distribution of business between the travel agents, it was necessary to be able to look at the University's travel expenditures as a whole. Therefore, on a monthly basis, a clerk was required to manually consolidate the seven sets of agent reports into one set of summary reports. This was a very time consuming task. In addition to the large amounts of time spent on the manual manipulation of data, Travel Services was limited to a specific set of reports the travel agents were providing.

Based on the experiences gained in the first year of the program, new contracts were negotiated with the designated agents that required data be reported on magnetic media. Travel Services now receives two data files from each of the designated travel agents. One data file contains information regarding each of the airline tickets issued to University travelers. The other file contains data concerning all hotel bookings and car rentals made through the agent. These two files are downloaded from the agent's system to magnetic tape or floppy diskette. The files are then loaded onto Travel Services' computer system and run through a program which creates a master air file and a master hotel/car file. Since the seven designated agents use either American Airlines' Sabre reservation system or United Airlines' Apollo reservation system, a program to merge the unlike data file formats was developed.

Once the data is loaded onto the system, the travel coordinator has the ability to run several pre-programmed reports. Some of the reports include the following: air travel expenditures by cost center, destination analysis summary report, airline summary report, hotel booking summary report, rental car summary report, and minority vendor summary report. The system allows the user to either print these reports or display them directly on the workstation.

These data files contain all information pertaining to each booking, so the reports that may be generated can be quite detailed. One report that was created listed all round trips from Detroit to Washington D.C. and the number of nights stayed in Washington D.C. hotels. This information was used in negotiating discounts with hotels. In another example, a report listing the number and dollar volume of domestic and international flights was generated. These are just a few of the types of reports that are now available to Travel Services.

In addition to the travel agency report system being used by Travel Services, there is a corporate cardholder management system. This system is used to keep track of all current accounts, pending applications, and cancelled accounts. Each cardholder record contains several pieces of information: campus address and telephone number, cost center and organization code numbers, American Express account number, and preferred travel agencies. In the agreement with American Express, the University is required to notify all cardholders who are thirty days delinquent in their payment. This is accomplished by loading a tape produced by American Express at the end of each billing cycle and running a program that prints a dunning notice for each delinquent cardholder. The cardholder file is also used to produce mailing labels for the newsletter published by Travel Services and for any correspondence relating to one of the designated travel agents.

At this time, the vendor summary management reports received from American Express are in a hard copy format. A system is under development that will allow the University to receive the source data for these reports on magnetic tape. When completed, Travel Services will have the ability to generate its own reports and maintain a history of the vendor summary data on disk. Plans are also being made to allow online communications between the University and American Express. With messaging capabilities, routine requests could be sent electronically rather than having to wait until the University's assigned analyst at American Express can be contacted by phone.

Conclusion

Information technology has played a major role not only in the computerization of the travel industry, but also in the ability of colleges and universities to improve their control over travel expenditures. However, the benefits of improved control over travel are not just tangible savings. An institution that can demonstrate it has taken steps to reduce travel costs may have an advantage in seeking federal and state funding, research grants, and other sources of support. In addition, an institution and its travelers will benefit from the increased level of service that can be obtained.

On-line Access to University Policies and Procedures:

An Award-Winning Administrative Information System

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Abstract

As one component of a university-wide move toward the electronic office, Virginia Tech has implemented an on-line Administrative Information System. The system makes available to the university community, in a cost-effective manner, policies, procedures, and general management information in an electronic Fact Book. The information system is centrally maintained and has eliminated the need for every office on campus to keep paper copies of the Administrative Handbook and other policy manuals. The system has been in use for more than a year and won an honorable mention award from NACUBO for its cost savings.

This paper provides 1) a brief history of the development of the system, 2) a discussion of the design issues that were identified and addressed during implementation and testing, 3) an analysis of usage statistics during the first 16 months of operation, and 4) a demonstration of the system.

Introduction

The Administrative Information System (AIS) at Virginia Tech replaced a traditional systems and procedures manual by taking advantage of the university's significant computing and communications resources. The new system, which has been in operation for 16 months, was designed to resolve audit comments regarding the timely availability of current administrative policies and procedures. Though developed outside of the university's normal administrative data processing environment, the AIS was also viewed as an extension of the administration's commitment to office automation.

This paper provides a brief overview of the development of the AIS, the necessary conditions of its successful implementation, the design issues raised and resolved during development, and usage statistics for the first full year of operation.

Prerequisites

The development of AIS would not have been contemplated had there not been support of extensive office automation through universal departmental access to the university's IBM 3090 computer. Development of the AIS was also predicated on both a strong commitment to office automation by the entire executive administration and a high level of acceptance of office automation by staff and faculty. The level of acceptance among staff was considered to be especially critical since clerical and secretarial staff were typically more directly involved with administrative procedures than faculty. The administration was committed from the outset to an on-line system. This commitment was evidenced by the fact that the decision to implement AIS was taken without any cost/benefit analysis. In large measure, these factors have contributed to the positive acceptance of the AIS. In the absence of these factors, the system probably would not have been successfully implemented.

Progenitors

While the university's primary information systems were based on IMS, which had a long history of user training and security control, by 1985 the university had already begun to implement administrative applications under CMS. Almost all of these applications had been developed by departments outside of the normal administrative data processing areas.

Like most systems, the AIS had several progenitors that influenced both the decision to implement an on-line system and the system's design. In 1982 a prototype system was developed by the Computing Center to display the *Faculty Handbook* at a user's terminal. This system displayed simple text files by selecting the appropriate section from a "point and push" table of contents menu. The system represented a proof of concept prototype but it was never developed beyond the prototype stage. In addition to this system, the availability of on-line HELP under CMS and Computing Center News items offered under a customized CMS HELP menu prompted development of other systems that influenced the design and implementation of the AIS.

Independently, Institutional Research and Planning Analysis (IRPA) developed and implemented an *Electronic Fact Book*. Based on the CMS HELP facility, this system provided on-line access to standard reports available in print in the *University Fact Book*. The *Electronic Fact Book* displayed simple text files from a series of "point and push" menus that mimicked the look and feel of the basic CMS HELP facility. This system was developed, tested, and installed by IRPA during 1984 and operated as an independent application until it was incorporated into the AIS. After introduction of the *Electronic Fact Book*, the Admissions Office installed the *Admissions Information System* that made weekly admissions summaries available on-line. This system was also based on the CMS HELP facility and offered an enhanced system that monitored user access in order to evaluate system usage.

A number of other departments also offered on-line "systems" that permitted users to view text files containing their standard operating policies and procedures. Like the *Standard Operating Procedures* offered by Sponsored Programs, these displays frequently amounted to little more than a listing file that the user could view with standard CMS commands such as XEDIT or BROWSE.

All of these systems required a user to link to a CMS mini-disk and execute a command; to establish the link in the PROFILE EXEC and remember the appropriate command; or to create a custom exec file that linked to a mini-disk and executed the appropriate command. Only those systems based on the CMS HELP facility offered a consistent and familiar "look and feel."

There were several progenitors of AIS that set precedents for on-line access to administrative information. These systems influenced the administration's objectives for the AIS and its design criteria. These progenitors also anticipated some of the problems with on-line access to administrative information under CMS that have yet to be resolved.

Getting Started

One of the initial difficulties encountered in the development of the AIS was the lack of an appropriate "home" for the system. Administrative data processing at Virginia Tech has been decentralized for many years. As a consequence, no single administrative department had a clear responsibility for the entire system. While it was clearly recognized that the Vice President for Administration and Operations had the responsibility for the *Administrative Handbook*, his office had no systems development or programming support. In addition, few administrative departments had developed or wanted to develop systems under CMS, since their primary experience was in IMS.

Under the direction of the Vice President for Administration and Operations, each department was trained in basic DCF/GML tags and assigned the responsibility of preparing a source document that would be incorporated into a single Policy Digest. The original intent was to provide access to the Policy Digest under CMS and to make it available as a monolithic printed reference. Based on its experience in developing the Electronic Fact Book, staff in IRPA were assigned the task of researching design alternatives, developing the display system and supervising its implementation.

After initial review of the development of the policy and procedure documents, IRPA staff identified a critical need for an editor to provide technical writing assistance and to supervise the markup of each document. By January of 1986, an editor was hired and the development plan completed. The development plan called for initial system testing on July 1, 1986 with full implementation the following September.

In common with most of its progenitors, the AIS system was largely developed outside of the normal data processing departments. It was not until July of 1987 that the AIS system was formally assigned a permanent staff and placed under the control of the Office of University Services.

Design Issues

Given the decision to replace traditional systems and procedures manuals with an on-line system, several design issues were identified. These issues evolved as the system was designed and were not part of the decision to implement an on-line system.

Single-Source Files

One of the earliest decisions was to design a system that utilized a single-source file to produce both on-line files, supplemental printed versions of the policies, and typeset-quality text where necessary. This decision reflected a recognition of the resource requirements to maintain multiple files and a desire to avoid errors and omissions in several file versions. DCF/GML (IBM's SCRIPT) was selected as the basic text programming language. Basic printed documents were to be provided on the 3800 page printing system. In addition, IBM's 4250 printer provided the capability to produce professional-quality typeset text where this was desired. The system was successfully developed using the single-source document concept.

Display Text Files

The decision to use a single-source document in DCF/GML dictated a design of the on-line display system based on the storage and retrieval of electronic page images. Sections of each document were stored as text files under CMS and the AIS software was designed to select the appropriate text file based upon the system menu and use input. Virginia Tech's Systems Development department provided a basic Display Management System panel, which was used as the AIS main menu. This was the only part of the AIS developed by Tech's data processing professionals. Primary displays in the AIS were based on IBM's XEDIT full-screen editor with customized edit profiles that limit the commands available to the user.

This design decision led to a large number of files, over 1400 at this writing. However, the algorithm to create the display files from a single Script source file and the basic display algorithm was quite simple. By keeping the mechanics of the display system simple, we were able to focus our efforts on the readability of the basic documents and the consistency of text markup from one document to the next.

Responsibilities

Each department issuing policy was assigned the responsibility for its own document and was asked to prepare the initial source file. The AIS editor was assigned the tasks of editing the department's original material and developing a consistent markup style for all documents. The initial objective was to ensure that each document was written at the 10th grade reading level and satisfied generally accepted standards for technical English. Our intent in attempting to achieve the 10th grade reading level was to make the reader's task as simple as possible. We felt that the on-line display posed enough challenges without expecting the reader to comprehend text written at higher reading levels. We believe that this decision had a significant impact on user acceptance of the on-line display.

These responsibilities were established early in the development process and have worked well. Since a consistent markup style for all documents proved to be an essential element in the AIS system, we have been successful in achieving this goal in almost all of the documents available on-line. Improved readability was not one of the administration's original objectives for the AIS, but it has emerged as one of the better unintended benefits. While we have not yet achieved the targeted reading level in all documents, we have made significant progress. Most of the documents available under the AIS are reasonably close to the targeted 10th grade reading level. We have encountered some resistance to lowering the reading level, especially in documents such as the *Faculty Handbook*. It has also proven to be difficult to achieve a consistent text markup in documents such as the *Faculty Handbook*. Where resistance has been encountered, the AIS Editor has yielded to practical realities and merely suggested less cumbersome wording and more consistent text markup.

Printing

An initial design objective was to minimize the amount of printing done through the AIS. One of the primary objectives of an on-line application was the ability to update policies and procedures without the delays normally associated with systems and procedures manuals. It was readily apparent that one of the possible drawbacks to this approach was the possible existence of out-of-date printed documents. The traditional systems and procedures manuals remedy this problem by collecting all of the out-of-date material as verification of appropriate updates to the manual. This approach was clearly not feasible for an on-line system. To date we have not experienced problems with out-of-date policies and procedures, but we do not have sufficient experience to determine if this will continue to be the case.

After some review, it was decided to support three levels of printing. First, draft printed copies of the contents of each display file would be provided using the XPRINT command under XEDIT. The draft print facility can be invoked from a PF key while viewing any of the text displays in the AIS. A second level of printed distribution is provided in which full copies of each document may be printed from a "point and push" menu. The basics of this display were borrowed from the Computing Center's Documentation System (DOCS) and the user interface improved so it was similar to the Table of Contents menus in the AIS. These documents, which are stored in an MVS library, are printed on IBM's 3800 Page Printing System and delivered to the user's output distribution box. Delivery can usually be expected with one hour of a print request, though the user can control print priority, which determines both delivery time and printing cost. A third level of printing involves the production of camera-ready copy that can be used to print large numbers of distribution copies. An example of this type of printing is the *Traffic Rules and Regulations* brochure, which the university produces each year and distributes to students, faculty, and staff. With the installation of IBM's 4250 printer, the university's ability to provide high-quality camera-ready copy has been significantly improved.

While we have not monitored draft printing, we have maintained statistics on the number of documents printed under the AIS. Over the past 16 months, we have printed on average about 128 documents per month from the AIS. The total number of documents available for printing on the 3800 printer from the AIS has grown from 16 when the system was first installed to 30 documents at the time this paper was written. We have provided camera-ready copy for only one publication, *Traffic Rules and Regulations*. It appears that the availability of printed copies on the 3800 page printer has reduced the demand for more traditionally printed documents. It may well be that the next revision of the *Faculty Handbook* will not be provided in any form other than that available on the 3800.

Off-campus users

As a major research university with a traditional land-grant mission, Virginia Tech has departments, off-campus instructional centers and Agricultural Research Experiment Stations throughout Virginia. For these remote departments, an on-line system has not proven satisfactory. The problems we have encountered are largely due to the relatively high cost of telecommunications services and the spotty quality of communications service available over the state's wide area telephone service. For off-campus departments, AIS did not provide a satisfactory means of documenting administrative policies and procedures. For these departments, the university periodically prints updated policies and procedures and ships the documents to off-campus users. Other universities considering the development of a similar on-line system would be well advised to consider the issue of off-campus access during the initial stages of system planning.

CMS or PROFS?

At Virginia Tech, the user community has evolved into two groups; those who use PROFS as the predominant application and those who use CMS. Many of the most sophisticated users had a significant commitment to CMS long before the university's formal commitment to office automation and the concomitant installation of the PROFS system. These sophisticated users made infrequent use of PROFS and preferred the native CMS environment. On the other hand, there were large numbers of users who knew virtually nothing about computing other than the facilities provided in PROFS. Unfortunately the look and feel of these environments differed considerably.

It was not considered feasible for AIS to support both of these conventions and one of the most difficult initial design decisions required the selection of one set of conventions. The PROFS conventions were selected because it was felt that the least-experienced users would less difficulty learning how to use a system based on PROFS conventions. Many of the least experienced users were clerks and secretaries who were expected to be the system's most frequent users. The initial design decision was to make AIS available from one of the PROFS menus and to provide a seamless transition from PROFS to the AIS. Consistency with PROFS conventions was, however, not maintained in the "point and push" selection of items from the Table of Contents menus. The overall system design would probably have been improved by maintaining strict consistency with either CMS or PROFS conventions. The issue of "look and feel" was, however, not limited to the AIS system alone.

How many user interfaces?

The PROFS interface decision reflected part of a larger question raised by the proliferation of CMS administrative applications. How many user interfaces were to be permitted? In effect, what was the total amount of user training/learning required to function in automated office environment? This issue has not yet been resolved at Virginia Tech. CMS-based administrative applications have continued to proliferate. At this time we have not developed a formal policy regarding the conventions these systems should use nor have we attempted to coordinate security or electronic signature controls in CMS administrative systems.

Other institutions considering the development of on-line administrative applications should give serious consideration to this issue. In theory it should be easier to decide upon a consistent "look and feel" and to develop applications to this standard. The establishment of a consistent "look and feel" standard should also minimize the amount of time user's spend learning to use administrative applications. Over time, the absence of a consistent standard at Virginia Tech may limit the acceptance of on-line CMS administrative applications.

Security

Surprisingly, security was not an issue in the development of the AIS. From the outset, the intent was to foster universal access on the part of faculty, staff and students. Any user may access the system without special authorization and view university policies and procedures or print a copy of a document. Security precautions were limited to specific XEDIT profiles that do not file user changes to the policies displayed on the screen. To date we have had no problems with mixed student, faculty and staff access.

How much information to display?

Despite our efforts to keep things simple, we encountered typical design issues that had a big impact on the novice user. Among these were decisions on how much information was to be contained in each of the display files. We found that one- or two-paragraph display files often presented information out of context. This led either to multiple user selections from the menu in an attempt to gain the context for a particular policy, or to misunderstanding of the policy or procedure due to a lack of context, or to complete user frustration evidenced by immediate termination of the session. On the other hand, we found that providing too much text made it difficult for users to find what they needed to know quickly, thus obviating one of the advantages of an on-line system. We settled on major subheadings (e.g., section 1.1) as an appropriate compromise, but this decision required considerable care in developing a consistent style among documents prepared by many departments. In retrospect, we could have saved considerable time by identifying and resolving this issue before we began the preparation of the initial source documents. We could then have trained each department in the development of policy and procedure documents under a consistent style. Institutions contemplating similar on-line policy displays could learn from our experience.

Emphasis and organization

Emphasis and organization also proved to be a markup issues that required consideration in light of on-line video display. Many of the documents originally had underscores for emphasis, but on a CRT display, underscores took a full line (approx 5%) of the display. We also found that text justified to both the right and left margins was more difficult to read. We settled on CAPS for emphasis based on capital letters in the on-line display and ragged right justification. We also found that it was important to eliminate the blank lines produced by IBM SCRIPT at the end of some of the display files, and that the inclusion of positive top and bottom of file indicators helped users to maintain their orientation in the file.

Index

We also found that an Index was extremely helpful in finding the appropriate section of a document in the on-line display. The basic GML Index tag, however, provided page references which were useless as an index to the on-line display. We solved the problem by writing a REXX EXEC that converted page references into section references (e.g., 1.1). Section references have provided a convenient Index for on-line users. The Indices would also be more helpful if we had developed a consistent policy regarding index references at the outset. Since each department was responsible for its own document(s), the use of keywords or index references varied from one document to another. The documents in the AIS would be easier to use if we had established a consistent policy regarding index references and trained each department to implement this standard. While the administration had originally envisioned a single, monolithic document with a single comprehensive index, the AIS system abandoned that concept early in the development process. A monolithic document proved to be unmanageable since minor revisions to one policy impacted the entire document. We have attempted to provide a reasonable index to each document, but have not provided a master, comprehensive index for all documents.

Absence of Forms

The AIS could not display exact images of many of the administrative forms used on the campus. Most systems and procedures manuals have numerous copies of institutional forms that can be referenced in the manual. With the obvious technical limitations of a CRT display, this was not possible under AIS. While this represents a significant shortcoming when compared to traditional systems and procedures manuals, we have not had major problems with this as of this time. Our Employee Relations Department runs training programs that cover each of the major administrative procedures and our Internal Audit Department has not taken exception to the absence of exact replicas of these forms in AIS.

Archives

One direct benefit of AIS has been the implementation of historical archives of institutional policies and policy changes. Heretofore, the university had no central summary of policy or procedure changes. The AIS display contains a Revision Status section for each document. Detailed notes are provided in this section on any changes that have been made to the document. The system archives also contain complete copies of each document that preserves an historical record of policy changes.

System Usage Statistics

To determine if the system was being used and to provide departments with information to departments about usage of their sections, an enhancement was added to the system that monitors usage. For the past 16 months, each time a user has viewed a section or has printed a complete document, the usage monitor has extracted the user's ID, the identifier of the policy being viewed or printed, along the date and time. This information has been monitored routinely to gauge the system's effectiveness. Since the implementation of usage monitoring, we have been able to track usage by department as well as individual user.

The accompanying tables illustrate system usage over the last 16 months. During a typical week, over 100 individual users have accessed the AIS. Total system usage has averaged over 200 calls per week. During this time over 2000 documents have been printed from the AIS Print-a-Document menu. System usage varies with academic sessions and holidays, but this variation is typical of most administrative systems and overall computer usage as well. To date the administration has been satisfied with overall usage statistics.

Virginia Polytechnic Institute and State University Administrative Information System
Weekly System Usage Since Startup

Week		Accesses	Userids
June 30, 1986	July 6	150	101
July 7	July 13	211	138
July 14	July 20	147	89
July 21	July 27	86	48
July 28	August 3	114	66
August 4	August 10	127	75
August 11	August 17	112	65
August 18	August 24	118	73
August 25	August 31	73	51
September 1	September 7	64	46
September 8	September 14	140	79
September 15	September 22	160	105
September 22	September 28	107	67
September 29	October 5	141	89
October 6	October 12	109	65
October 13	October 19	144	83
October 20	October 26	140	87
October 27	October 31	168	93
November 1	November 9	195	99
November 10	November 16	204	102
November 17	November 23	172	82
November 24	November 30	148	77
December 1	December 7	238	127
December 8	December 14	201	117
December 15	December 21	202	97
December 22	December 28	61	35
December 29	January 4	54	30
	1987		
January 5	January 11	328	167
January 12	January 18	291	144
January 19	January 25	227	112
January 26	January 31	242	97
February 1	February 8	385	128
February 9	February 15	282	133
February 16	February 22	331	167
February 23	February 28	290	143
March 1	March 8	269	151
March 9	March 15	457	218
March 16	March 22	369	199
March 23	March 29	357	172
March 30	April 5	345	181
April 6	April 12	270	153
April 13	April 19	383	177
April 20	April 26	298	161
April 27	May 3	361	176
May 4	May 10	357	180
May 11	May 17	338	200
May 18	May 24	455	178
May 25	May 31	241	154
June 1	June 7	257	144
June 8	June 14	227	123
June 15	June 21	190	104
June 22	June 28	272	138
June 29	July 5	203	118
July 6	July 12	195	113
July 13	July 19	180	118
July 20	July 26	199	123
July 27	August 2	240	141
August 3	August 9	217	124
August 10	August 16	177	116
August 17	August 23	195	125
August 24	August 30	199	124
August 31	September 6	228	128
September 7	September 13	212	121
September 14	September 20	216	144
September 21	September 27	207	145
September 28	October 4	216	134
October 5	October 11	198	130
October 12	October 18	215	144
October 19	October 25	204	131
October 26	October 31	193	125

Virginia Polytechnic Institute and State University Administrative Information System
Print-A-Document Requests, July 1986 to October 1987

	1986						1987									
DOCUMENT	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**
AIS User Instructions	27	7	6	9	3	3	8	2	7	4	8	5	3	4	2	5
Faculty Handbook	12	6	9	7	8	8	14	22	13	5	11	6	22	12	15	4
Proposal Preparation - Sponsored Programs	12	6	5	6	2	3	5	2	3	1	11	2	1	1	3	4
Student Life Policies	4	4	0	2	3	0	4	2	2	0	2	3	1	4	0	1
Laboratory Safety	9	5	5	8	1	5	3	10	13	25	9	1	0	13	0	1
Radiation Safety	4	5	3	35	3	5	8	5	4	3	5	1	11	17	2	2
X-ray Safety	3	5	2	13	1	0	1	2	3	5	1	1	0	1	1	1
Safety Rules for Jobs & Tools	5	2	2	1	1	1	2	1	2	3	0	1	0	2	2	1
Animal Research Policy	6	4	0	3	0	1	2	0	2	2	2	4	0	3	1	2
Physical Plant Dept	9	7	12	4	0	3	5	1	4	0	1	5	1	4	1	4
University Services	12	4	2	6	1	1	3	1	1	1	3	6	2	2	4	3
Communications Network Services	11	7	5	8	2	1	5	1	7	5	6	4	4	4	2	6
Purchasing Handbook	11	5	18	14	5	2	6	7	10	7	6	8	6	6	6	4
Finance Handbook	15	8	10	13	10	3	9	7	5	5	8	6	4	9	13	5
Traffic Rules	6	2	2	2	1	1	2	1	2	0	4	1	0	1	0	2
Employee Relations	14	13	11	10	4	2	7	5	11	1	24	9	9	8	1	3
Graduate School Policies			3	7	4	1	3	2	6	2	7	8	1	4	0	3
Central Stores General Catalog					6	3	14	9	101	23	37	15	11	17	25	19
Central Stores Physical Plant Catalog					3	0	6	4	41	8	22	8	8	6	13	9
Biosafety Handbook							3	0	0	3	0	0	0	1	1	1
Space Allocations									7	0	0	1	1	0	1	0
Computer Equipment on State Contract									17	31	20	10	17	4	13	43
Chemistry Stockroom Catalog									5	2	13	0	2	3	3	2
Employment Interviewing Handbook										7	15	6	5	2	4	2
Faculty Recruitiment										4	2	1	0	1	3	0
Handicapped Student Services										3	0	0	1	0	0	1
Vet Medicine Student Handbook										3	1	1	0	1	3	0
Care and Use of Research Animals														5	1	1
Honor System Constitution															1	0
Academic Policies															2	8
TOTAL	**160**	**90**	**95**	**148**	**58**	**43**	**110**	**84**	**266**	**153**	**218**	**122**	**114**	**137**	**123**	**137**

Synergy

The AIS system began life as the "Policy Digest" since its original intent was to provide policies and procedures. Its mission was, however, soon expanded to include the Electronic Fact Book, Admissions Information, Presidential Policy Memoranda, Governance System Commission and Committee Memberships, Governance System Minutes, and Summaries of Space Allocations. These systems have remained a part of the AIS while other systems have been developed using similar user interfaces.

Within months of its implementation, AIS contained lists of surplus chemicals available free from the Safety Department and chemicals available in the Chemistry Department Storeroom. These were soon followed by a catalog of Central Stores supplies and equipment that featured on-line order preparation. (On-line orders were not developed due to internal control and security considerations raised by our Internal Audit Department.) These systems have been segregated into stand-alone applications.

Summary

While AIS began as a system available from a PROFS menu, the increased number of CMS administrative applications soon led to the installation of the INFO System, which was developed by the Computing Center. Since the INFO System was based on CMS conventions, its introduction led to the demise of the seamless transition from PROFS into the AIS. Departments have continued to develop administrative applications under CMS and the number of distinct user interfaces has continued to grow. This growth has been reflected in the increased numbers of applications and sub-menus available from INFO.

The system received a sixth-place cost-reduction incentive award in 1987 from the National Association of College and University Business Officers (NACUBO). Despite this award, the AIS must still be considered an experimental system. It was developed in a typical "skunk works" manner, incorporating elements from existing systems and working out design issues and problems as they arose. It was during its development a low budget system and it continues to be a low budget operation at this time. The system has been successful in achieving the major objectives established by the administration. How the system will fare over the long run and the eventual fate of other administrative applications under CMS will have to await the verdict of staff and faculty users in an increasingly complex automated office environment.

AFFORDABLE TOUCH-TONE PHONE STUDENT REGISTRATION AND SELF-REGISTRATION WITHOUT MORTGAGING YOUR COLLEGE

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This paper describes one institution's innovative approach to providing inexpensive registration methods without overextending a college's financial situation. Both touch-tone phone registration and self-registration systems are reviewed.

AFFORDABLE TOUCH-TONE PHONE STUDENT REGISTRATION AND SELF-REGISTRATION WITHOUT MORTGAGING YOUR COLLEGE

BACKGROUND

Waubonsee Community College, a two-year public institution of higher learning, was established in July, 1966 and is located approximately 50 miles west of Chicago, Illinois. The area served by Waubonsee Community College encompasses approximately 600 square miles and includes twelve public school districts. The College's name, meaning "early dawn" or "early day", was chosen to honor a Pottawatomi Indian chief who lived in the Fox River Valley during the 1800's.

Waubonsee officially opened its doors for classes on September 11, 1967, to an initial enrollment of 1,603 students of whom 403 were full-time and 1,200 were part-time. The College has continued its growth pattern and the fall of 1986 showed 5,304 students enrolled of which 1,057 were full-time.

A 183-acre tract of land located approximately two miles north of Sugar Grove on Illinois Route 47 was chosen and a permanent campus constructed. Seven buildings were constructed with the eighth building, the new College Center, being completed in the fall of 1982. In 1983, planning was begun for a major extension center in Aurora, where approximately one-half of the population of the district reside. A three-story building, which formerly housed Carson, Pirie, Scott and Company (retail clothing store), was renovated for educational purposes.

TOUCH-TONE TELEPHONE REGISTRATION SYSTEM

Waubonsee Community College is utilizing a touch-tone telephone registration system that was implemented in May, 1987. Student registration calls are routed through a modem card in an IBM/AT compatible, which in turn communicates with the on-line student system (HP-3000). Each modem card can handle up to four telephone lines. Waubonsee is utilizing five lines. Four modem cards can be inserted into an IBM/AT. The modem cards and PC software used in Waubonsee's touch-tone registration system was provided by Computer Communications Specialists, Inc. (CCS) of Norcross, Georgia. See figure A for CCS costs.

Any student who has ever attended Waubonsee previously has the opportunity to use the phone registration system. The system can handle registrations for multiple semesters at one time utilizing a four-digit coding system for each class. Touch-tone registration is available 24 hours a day, 7 days a week, allowing for a short back-up time every night. Students must call from a touch-tone phone which has touch-tone service.

Full-time and part-time students can register for both credit and/or non-credit courses. The system has the ability to check any of the following: required applications, required assessment testing, registration overloads, minimum age requirements, prerequisite authorizations for specialized courses, outstanding financial obligations, parking tickets, or library fines. The system can be modified to fit Waubonsee's changing needs. New program changes and the corresponding voice messages can be modified in-house without the additional cost and time of using an outside service. The College was able to utilize existing audio visual and PC equipment.

Waubonsee first offered phone registration service to the public in May 1987 for the Summer semester. One percent of students enrolled for summer used the system. Three percent of the students enrolled for the Fall 1987 semester have used the phone system to register. It is anticipated that the percentage of students using the system will continue to grow. Surveys indicate that the students have enjoyed the convenience of registering by phone, whether at home or work and intend to use the system again. About one-half of the students would like to use the system to pay their tuition by credit card.

Students can add a course, drop a course, check for open courses, check their schedule, or check their current balance due by phone. They are only charged a user fee if they add or drop courses. The system and script are both user-friendly and provide self-help menus and instructions.

TIME LINE

July 1986	Initial inquiry about CCS registration system
August 1986	Dean of Information Systems visits CCS in Norcross,Georgia
September 1986	Presentation to adminstrative staff
September 1986	Presentation to Board of Trustees
December 1986	Final contract signed
January 1987	Arrival of equipment
January 1987	HP3000 interfaced with CCS equipment
February 1987	Script
March 1987	Testing
April 1987	Promotional advertisement
May 1987	Phone system made available to public
June 1987	Final round of surveys
October 1987	Second round of surveys

Overall Hardware and Software Configuration

Overall hardware for the college includes:

3	HP-3000 computers with 142 ports
1	IBM-4361 with 32 ports
+200	Personal Computers
2	386 computers
1	Dytel Automated Attendant System
1	AT&T Dimension/400 Phone System
1	AT Dytel Voice Mail System

The major philosophy of Waubonsee's Computing Plan is to maintain a distributive computing network of multiple, small, powerful, user friendly computers that support and communicate with each other.

Waubonsee has invested in 4th generation software that has allowed the development of its own administrative applications. The Hewlett Packard Data Base Management System and the Cognos Powerhouse software has made Waubonsee many times more productive. In our type of environment, it is usually wiser to purchase software that makes us more productive in application development, rather than purchasing turn-key application packages.

The (3) HP-3000 computers have (142) ports and support over (90) personal computers. Files can be up and down loaded from the PC's to the HP-3000's, as well as doing normal on-line and batch activities. The HP-3000's all run the same operating system and are fully compatible to each other. They back each other up in case of an emergency. We have never had to switch over to another HP-3000; but, if needed, this is part of our Problem Management Procedure. One of the HP-3000's is located in another building, the Learning Resource Center. This HP-3000 primarily serves the Library System with on-line circulation and cataloging. But, it also serves as a "hot site" for the other two HP-3000's, and is an important part of our Disaster Recovery Plan. The second HP-3000 is used for all administrative production computing. The third HP-3000 is utilized for academic computing, a high school network, and administrative systems development. The IBM-4361 is primarily an academic computer. See figure B for configuration overview.

Waubonsee's computing philosophy is to use personal computers whenever possible, utilizing the larger computers only when necessary. Word processing is an example of this philosophy. We have word processing on the HP-3000's, but almost all word processing occurs on the PC's.

Touch Tone Registration Hardware & Software Configuration

Waubonsee's Touch Tone Registration System follows the computing philosophy in that PC's are utilized with the larger computers only when necessary. Outside telephone calls come into a Dytel Automated Attendant System. The Dytel provides (5) phone extension lines into (2) CCS modem cards in an IBM/AT personal computer. See figure C.

The IBM/AT:

1. answers the (5) phone lines.
2. speaks the desired messages under program control back thru the phone line.
3. receives input from the student's touch tone phone.
4. sends records to the HP-3000 Student Data Base.
5. receives records from the HP-3000 Student Data Base.
6. digitizes voice messages through a microphone and stores it on the 30MB hard disk.

The HP-3000 takes a request record and processes it against the Student Data Base, and sends back the record to the IBM/AT. The HP-3000 thinks it is simply communicating with a terminal. All communication is asynchronous and ASCII.

The following is a brief description of adding a new message to the system:

1. Record the desired phrase using a microphone into the AT using the RECORD program. Example file name PK046.DAT which is our welcome message phrase.

2. Update the file name PK046.DAT into the phrase file named WAUBONSEE.DIR

3. Run the program VLIB. This inputs WAUBONSEE.DIR and outputs a combined phrase file called WAUBONSEE.LIB

4. Run the program MESSAGE. This defines a message that can be made up of one or more phrases. A unique message number is assigned.

5. Update the COMMAND.DAT file to include the new message number.

The COMMAND.DAT file provides the logic to the main operating program. See figure D. Each line of the COMMAND.DAT defines items like: current command number, next command number, message number, number of digits to accept from the touch tone phone, location of the data in the transaction record, and branching based upon the touch tone digit entered.

The HP-3000 host program is written in COBOL. It is written to take records from a terminal and process them against the Student Data Base, and then return a data record back to the IBM/AT with the next command number to execute on the IBM/AT.

An example is a student who calls in to register, but has an unpaid library fine. The student enters his social security number and access code through his touch tone phone to the IBM/AT. The IBM/AT under program control sends a request record to the HP-3000 COBOL program. The COBOL program checks the Student Data Base and finds the student has a "hold" because of an unpaid library fine. The COBOL program sends back a record to the IBM/AT telling it to execute a command number that speaks the message that the student has an outstanding financial obligation that must be paid before he can register. After thanking the student for using the Touch Tone Registration system, the IBM/AT disconnects the line.

SELF-REGISTRATION SYSTEM

In order to provide easy, convenient access to course information and the registration process, a self-registration system was designed. See figure E. Based on the concept of self-service, the system allows anyone to check for open courses, course time and course location. Full-time and part-time students who have attended Waubonsee previously can register for either credit or non-credit courses. Students can check their current schedule or courses completed, check their current financial statement, and receive pertinent information regarding the semester calendar.

During peak registration times, self-registration terminals are available in the Admissions and Records area and also in Counseling. Future sites include the extension campus and the Learning Resource Center. With a telephone line, a modem, and a portable CRT, registration sites are unlimited.

TIME-LINE

February 1986	Brain Storming
May 1986	System Design and Programming
June 1986	Testing
July 1986	Self-registration Available for Use

SUMMARY

With these inovative concepts, the old methods of maintaining records and financial accountable have drastically changed. These systems promote a paperless office environment. Due to the lack of paper "back-up", the computer generated listings of detailed transactions (audit trails) have become a crucial part of record keeping. Registration staffing probelms have decreased with the expanded availability of self-service registration systems. Part-time staff hirings have been virtually eliminated, with the full-time staff able to handle.

Other advantages of using these systems include: reduced salary budgets, expanded accessability to academic and registration information, expanded service hours without increasing the building/staff utilization costs, and providing a needed service for a growing student body.

With the flexibility of the self-service systems, future inovations are more easily adopted. Advertising course availability through the Waubonsee Instructional Television Fixed Service (ITFS station) where students can view selections, call in and register by touch-tone registration. Offering a credit card payment service through the touch-tone registration system. Allowing students to register through their home computer systems via the self-regtistration system.

CCS Costs

System DOS Platform Includes host-interface HW/SW, not mainframe program.	$ 7,000
(4) Line Module Card Max (4) cards per DOS Platform	$ 9,000
Record Facility	$ 4,500
	$20,500
Option: Credit Card Verification	$ 4,500

* Prices Subject to Change

** Maintenance 12% of purchase/year

figure A

WCC Configuration Overview

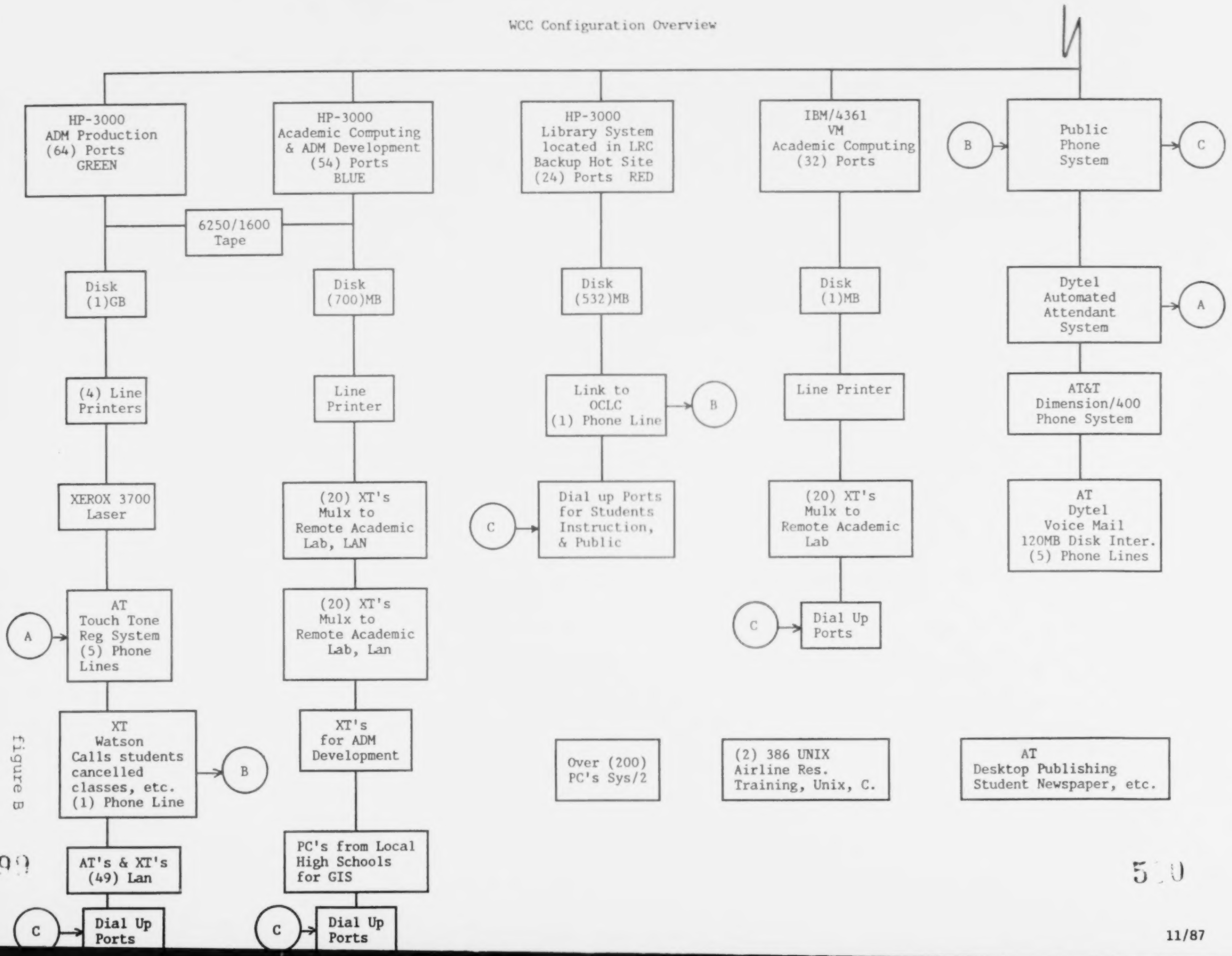
HP-3000
ADM Production
(64) Ports
GREEN
HP-3000
Academic Computing
& ADM Development
(54) Ports
BLUE
HP-3000
Library System
located in LRC
Backup Hot Site
(24) Ports RED
IBM/4361
VM
Academic Computing
(32) Ports
B
Public
Phone
System
C
6250/1600
Tape
Disk
(1)GB
Disk
(700)MB
Disk
(532)MB
Disk
(1)MB
Dytel
Automated
Attendant
System
A
(4) Line
Printers
Line
Printer
Link to
OCLC
(1) Phone Line
B
Line Printer
AT&T
Dimension/400
Phone System
XEROX 3700
Laser
(20) XT's
Mulx to
Remote Academic
Lab, LAN
C
Dial up Ports
for Students
Instruction,
& Public
(20) XT's
Mulx to
Remote Academic
Lab
AT
Dytel
Voice Mail
120MB Disk Inter.
(5) Phone Lines
A
AT
Touch Tone
Reg System
(5) Phone
Lines
(20) XT's
Mulx to
Remote Academic
Lab, Lan
C
Dial Up
Ports
XT
Watson
Calls students
cancelled
classes, etc.
(1) Phone Line
B
XT's
for ADM
Development
Over (200)
PC's Sys/2
(2) 386 UNIX
Airline Res.
Training, Unix, C.
AT
Desktop Publishing
Student Newspaper, etc.
AT's & XT's
(49) Lan
PC's from Local
High Schools
for GIS
C
Dial Up
Ports
C
Dial Up
Ports

figure B

11/87

WCC Touch Tone Registration System

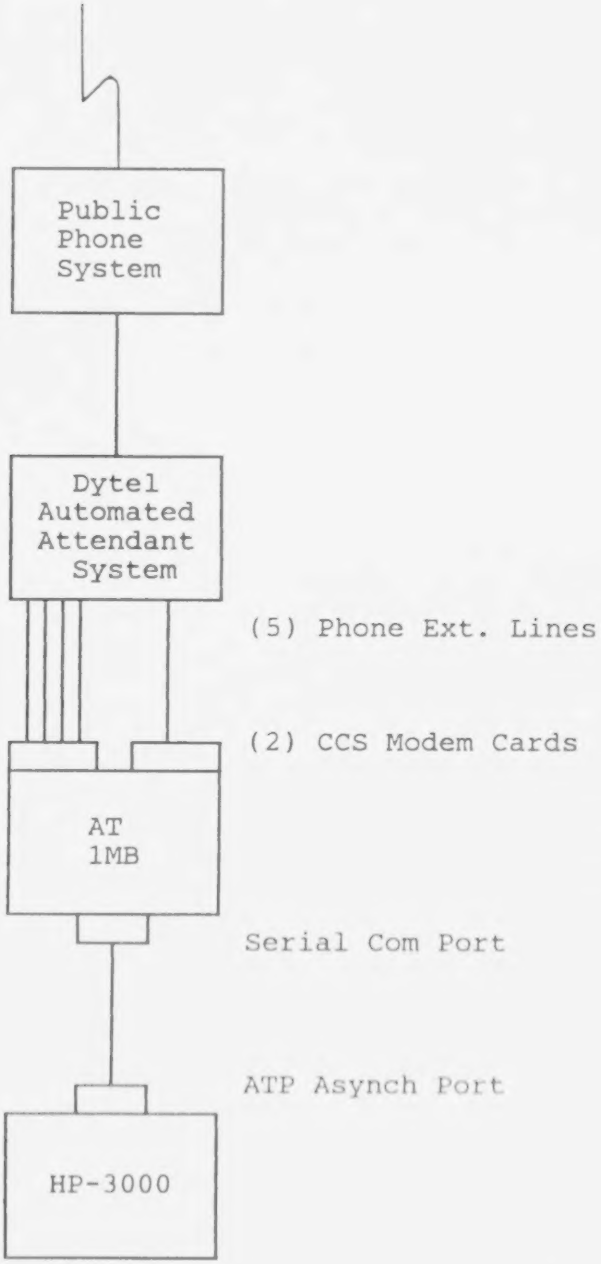
Public
Phone
System
Dytel
Automated
Attendant
System
(5) Phone Ext. Lines
(2) CCS Modem Cards
AT
1MB
Serial Com Port
ATP Asynch Port
HP-3000

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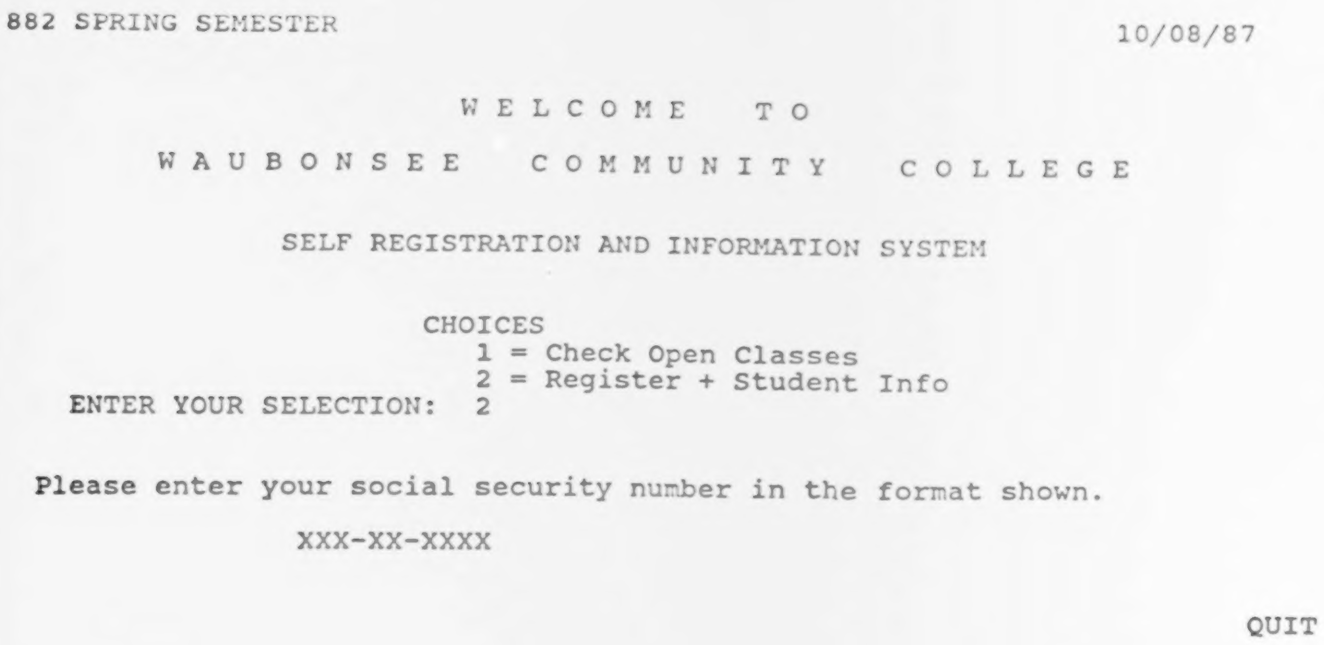
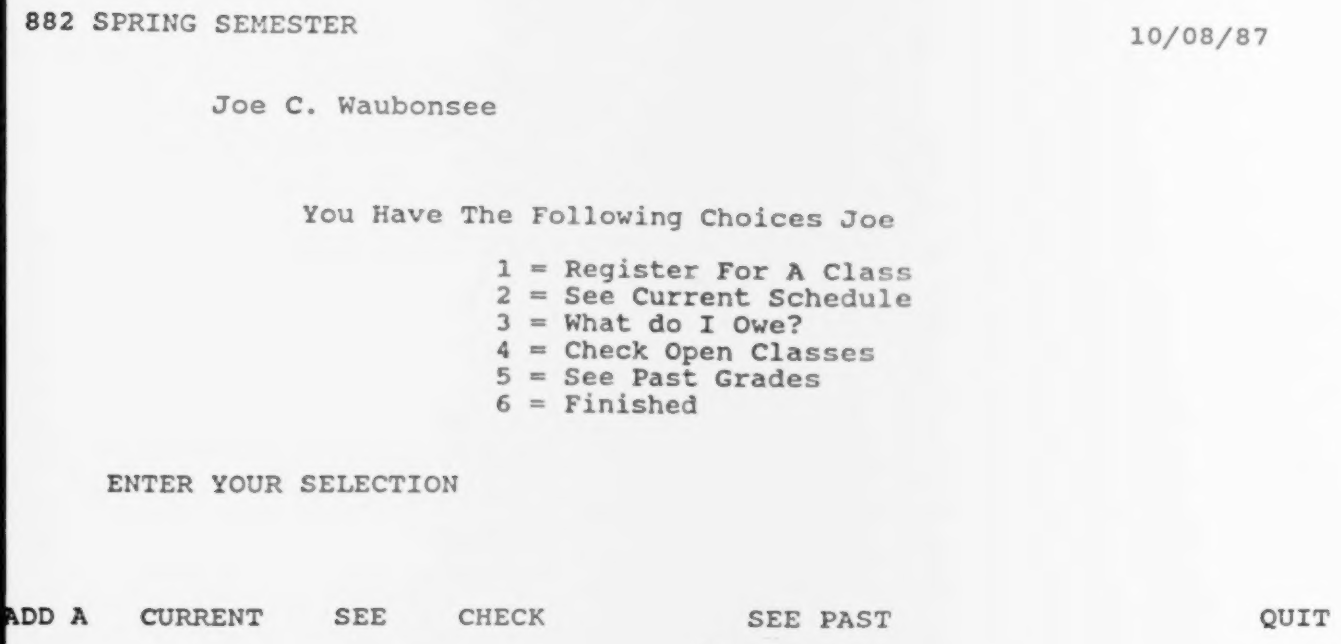
figure C

```
     |      |      |
CUR  |NEXT  |      |                     file=COMMAND.DAT
 COMMAND    |MSG#  |
     |      |      |
001  |002   |001   |00 00                                                                                          Welcome Msg.
002  |004   |002   |09 34## ** *# 001                                                                              Enter SSN
003  |002   |003   |00 00                                                                                          Invalid SSN
004  |HHH   |004   |06 44## ** *# 038                                                                              Enter A-CODE
005  |002   |005   |00 00                                                                                          Invalid A-CODE
006  |038   |006   |00 00                                                                                          Fin. obligation
007  |009   |007   |00 00                                                                                          Out Dist,Reg
008  |038   |008   |00 00                                                                                          Out Dist,NoReg
009  |010   |009   |00 00                    0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | # | * |Fin. Aid Messg.
010  |      |010   |01 34## ** *# 038 010|011|028|HHH|HHH|037|038|010|010|010|010|010|Menu
 .   |      |      |
 .   |      |      |
 .   |      |      |
038  |999   |038   |00 00                                                                                          Goodbye
039  |038   |039   |00 00                                                                                          Bad SSN, Bye
```

figure D



```
882 SPRING SEMESTER                                      10/08/87

                        W E L C O M E   T O

          W A U B O N S E E   C O M M U N I T Y   C O L L E G E

               SELF REGISTRATION AND INFORMATION SYSTEM

                      CHOICES
                         1 = Check Open Classes
                         2 = Register + Student Info
   ENTER YOUR SELECTION:  2

  Please enter your social security number in the format shown.

                 XXX-XX-XXXX

                                                              QUIT
```



```
882 SPRING SEMESTER                                      10/08/87

           Joe C. Waubonsee

                You Have The Following Choices Joe

                         1 = Register For A Class
                         2 = See Current Schedule
                         3 = What do I Owe?
                         4 = Check Open Classes
                         5 = See Past Grades
                         6 = Finished

    ENTER YOUR SELECTION

ADD A    CURRENT    SEE    CHECK           SEE PAST              QUIT
```

figure E

CUDA
An Adventure in Distributed Computing

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ABSTRACT

With the availability of personal computers and the escalating information and reporting needs of universities, college administrators are increasingly developing their own systems on microcomputers. The Cornell University Distributed Accounting (CUDA) system is an attempt to institutionalize this trend, provide departments a software tool for better managing their finances, create microcomputer standards, create a vehicle for better administrative microcomputer support, and insure local systems are consistent with central computer systems.

CUDA currently consists of 5 modules: accounting, budgeting, personnel/payroll, purchasing and reporting. The system provides standard management information reports and allows administrators to develop customized reports. The data can be downloaded from the central systems or entered locally.

Background

During the past six years there has been a major effort at Cornell to computerize the central administrative functions. The university has been successful in providing computing for many central offices, but until recently has paid little attention to departmental administrative computing needs. With much of the central system development work complete, Cornell Computer Services (CCS) is taking a close look at departmental information needs. Since funding and financial decision making is decentralized at Cornell, the accounting office was one of the first to recognize the need to improve the quality of information provided to departments.

The central accounting system meets the needs of accounting personnel who understand and take full advantage of the information provided by the system daily. It does not fully address management information needs outside the accounting office. Information is disseminated to departments monthly in reports. This dated information, along with unneeded data, has proven to be too much and too infrequent for departments to make timely decisions. Standard accounting reports are often considered difficult to read or insufficient by departmental managers. Since a substantial effort would by required by data processing staff to create special reports to satisfy over 300 departments, many departments have had to do without.

To alleviate this problem, almost all of the departments maintain manual records, and some have computerized their financial record keeping. These departments were rekeying data from monthly accounting reports so that the data would be in a more usable format. Some of the departments hired their own data processing staff to write special reports and provide a mechanism for keeping data not collected by the central system. Because of restricted access to the accounting files, the need for special reporting capabilites and the need for more timely information, independent systems have been developed and have flourished. These local systems often caused more problems than they solved. They resulted in inconsistent information between the departmental and central accounting systems, and duplications in effort. There was a clear risk that if better services were not provided centrally, more departments would go in their own direction with the danger of misinformation and mismanagement of departmental funds.

To meet departmental needs, the accounting office formed a committee to execute three goals. The first goal was to provide on-line mainframe access to current data. The second was to provide the capability to download data for departmental usage. Central financial data has been available for use on microcomputers for a number of years, but it could only be used by those administrators with relatively good computer skills. Procedures for downloading the data were complicated, data reformatting was necessary for use in software packages (e.g., LOTUS), and familiarity with microcomputer software was necessary.

The third goal and topic of this paper was to provide standards, a support network and a functioning micro-system so the downloaded financial data would be efficiently used and correctly interpreted according to the guidelines of the central system. Instead of designing a central system that would be all things to all people, the intent was to make the central system information easily available and, at the same time, provide the departments with the ability to decide for themselves what data they wanted and how they could manipulate it to meet their local needs. With downloading, duplicate data entry was no longer necessary, and time could be spent more productively. Many departments were also developing software to meet their needs. This often led to the university paying for redundant programming. It is hoped CUDA will displace this practice.

Starting the Project

So began CUDA, Cornell University's Distributed Accounting. The CUDA project seeks to provide a foundation for local departmental financial systems. By providing a foundation, the departments would be assured of having central system data locally available, a basic set of procedures and software for using the data, and a common starting point for their local system. The departments could build on the foundation of common file layouts and programs to meet needs specific to their department.

The CUDA project is guided by a committee formed by the Controller's office. This committee consists predominately of Cornell administrators, representing large and small, endowed and statutory, non-enterprise and enterprise departments. Their funding sources (and consequently tracking/reporting needs) are as varied as their personalities. They decided what systems were needed and developed the specifications for those systems. CCS and the central university administration also had representation on the committee.

The committee identified the objectives and defined the scope of their study. The overall objectives of the project were to provide the departments a solid foundation for building their local office management system which would be compatible with central systems. Functional areas to be implemented would be accounting, payroll/personnel, receivables, purchasing, budget, inventory. The departments would be given access to central system data and an easy to use download procedure. Departments would be encouraged to share software, computer knowledge, and financial knowledge.

Scope of the Project:

1. To decide on appropriate hardware and software.
2. To work out an easy downloading procedure and ability to select and format data in a user specified way.
3. To define conceptual and technical specifications for accounting , payroll/personnel, receivables, budget, purchasing, and inventory.
4. To work with central administrative offices to agree on data to be downloaded from the central systems and the presentation of the data in local screens and reports.
5. To set programming and program documentation standards for all PC CUDA programmers, including non-Cornell staff.
6. To provide clear documentation, microcomputer training (CUDA and general), security, and back-up procedures.
7. To allow for additional files and data elements to be used by the local systems.
8. To provide a core set of programs to handle data entry and reporting and data extraction and downloading from central system ADABAS files.
9. To provide a hotline for problems and questions, help available on microcomputers, mainframe, CUDA, accounting, payroll/personnel, writing custom software.
10. To start a bulletin board and software library for administrative users where new software, helpful tips, and financial news can be posted.
11. To form a CUDA users group to share ideas and software.
12. To establish a procedure to evaluate CUDA.

The committee of departmental administrators gathered a list of departmental needs that resulted in a system of 6 functional subsystems---accounting, accounts receivable, budget, payroll/personnel, purchasing, and inventory. Each functional module was given to 2-3 committee members to write a conceptual design and specifications. All the designs were put together into a specifications document and the entire committee reviewed the document for completeness. Once the committee was satisfied with the conceptual design, administrators, deans, directors and department heads were invited to review the project's specifications.

Once the conceptual design was complete it was obvious to all that the project and time/resources needed were too large. Accounting and Budgeting modules became a manageable phase one. Payroll/Personnel would be phase two followed by Purchasing. Committee members aided in the development of technical specifications from their conceptual design. Lists of needed files and their data elements were created. Central system files for accounting and payroll/personnel were reviewed for data elements needed by the local system.

Armed with file descriptions (data elements, size of record, number of records in worst case) and system specifications, the hardware and software options were investigated and requirements set. When considering hardware for this project it had to be produced by a stable company, have a large base of users on the Cornell campus, have a lot of software available, be reasonably priced (under $5,000), expandable, and CCS supported. The IBM-AT filled these requirements and has the power necessary to run the system. In addition to the IBM-AT, several IBM compatible also met the requirements.

When considering database software for this project it again had to be a stable company, have a large base of users on the Cornell campus, reasonably priced, easy to use, would support networking, and, if it was a programming language, it should be able to be compiled. The database users on campus were split between RBASE and DBASEIII. The ones seriously considered were RBASE, DBASEIII, PCFOCUS, and PARADOX. PCFOCUS was disqualified because of cost. PARADOX was disqualified because of newness of the company. RBASE and DBASE were very similar, but DBASE was chosen. RBASE was easier to use than DBASE and slightly faster, but DBASE had such a following on campus and in the general market that it was felt that Ashton-Tate and other vendors would improve and supplement the DBASE software.

The final and most important job of the committee was to keep the departments abreast of the project's progress, get suggestions from the departments and manage departmental expectations. This was done by periodic questionnaires, interviews of users, and open review sessions. It is important that departments understand what the project is trying to accomplish and when.

Software Development

Four people were involved closely with the software development. Business manager for the Johnson Graduate School of Management served as chairman of the CUDA committee and, on a daily basis, answered system specification questions for the computer staff. The Johnson School of Management also provided a full-time programmer with a background in micro-systems. The Controller's office provided a full-time person to test and document the system as it was being written. Computer Services provided a full-time analyst/programmer with a background in mainframe financial systems and a hobbyist's interest in microcomputers. The four people were housed in the Johnson School which served as one of the four alpha sites and provided the computer staff close contact with a user.

Early on, standards were set for CUDA programming. The goal was to achieve consistency in outward appearance of the system and internal programming code. To that end, standards dictated the use of:

1. Naming conventions for programs, files, variables, etc.
2. Centralized source code and log of changes.
3. Generalized program routines (i.e. error handling).
4. Consistent special key handling (i.e. CTRL-HOME adds a record).
5. A restriction to use only DBASE program code; no use of DBASE exits to call other programming languages including use of features that were exclusive to look alike products such as Clipper and FOXBASE.
6. Programming standards such as the use of "IIF" (immediate if) over "IF...ENDIF" because of faster execution time except if program readability was jeopardized.
7. Use of indentation and capitalization to aid in program readability.

As programs were finished they were given to the alpha sites. The alpha sites were now part of the project committee. At bi-monthly meetings, the project team reviewed problems and enhancements with the alpha sites. The committee decided work priority. For several months, this iterative process occurred: programming, release to alpha sites, requests for change or fix, committee review, scheduling the work, programming, and so on. When most of the requests were for enhancements and not bugs or problems, then preparation began for beta testing.

Coordination with the central systems

As a bi-product of the CUDA committee came some standardization of terminology. As the systems technical specifications were written and reviewed by departmental managers and central administrators a common vocabulary was agreed upon.

Access to central accounting files is granted based on a department having a mainframe computer userid. That userid has read access to specific account information. Departmental users can request central accounting to give them access to information concerning their departmental accounts. If accounting approves the request, the computer userid can then be used to access central accounting information for downloading to their local system.

Alpha and Beta Testing

The alpha test sites had to satisfy several criteria. Their business manager (user of the system) had to be well versed on Cornell's financial practices and procedures. Someone in the office had to be computer literate. The office had to have the equipment necessary to run the system and perform the downloading from the mainframe. Most importantly, the alpha site had to understand and accept the fact that the software was bound to contain some errors. The beta sites were chosen to represent every college at the university and to form as diverse a group as possible.

Both the alpha and the beta sites are responsible for testing and using the software and reporting any problems or enhancements desired. All test sites are given forms to fill out to request changes or report problems. If a problem occurs they are requested to also call, so action can be taken as soon as possible. Requests for changes or enhancements are taken up in committee meetings.

The computer personnel currently includes 2 technical consultants and 2 analyst/programmers. The 2 technical consultants are responsible for user assistance, system documentation, training, general communication (newsletters, demonstrations), and some maintenance programming. The analyst/programmers continue fixing problems and new development. The goal when a problem is reported is to fix it within 48 hours. Another group goal is to have someone knowledgeable covering the phone from 8:30 to 4:30. This sounds trivial, but with microcomputer systems much of the work has to be done at the user site, taking staff away from their office.

Short and Long Term Support

The computer support staff for this project currently consists of 2 technical consultants and 2 analyst/programmers. It is predicted that this level of staffing will be needed until the major modules (the 6 modules originally defined) are completed. After this time only the 2 technical consultants will be required. Currently these consultants spend most of their time preparing documentation and training users. The time required for this is expected to dwindle and be replaced with maintenance and enhancement programming.

This may seem like insufficient staffing for a system that could have over 300 users. It is hoped that from the project committee and from the alpha and beta sites will spring a user support network. There are indications that this is already happening. A goal for the 2 technical consultants is to provide a focal point for this activity, to help the network formation along, and to give the group a communication link into central computer services when greater computer technical expertise is needed. It is also expected that the project committee will continue to offer guidance to the systems users, encourage the user network, and provide a communication link with central administration to voice departmental needs.

Problems

The most obvious problem with the system is response time. DBASE is not noted for its speed. When the budget data entry programs were complete they were tried on an IBM-XT. They ran painfully slow. Thus the requirement of an AT was made. Compiling the programs helps and products such as FOXBASE (a DBASE look alike) greatly improves the execution time of the code (3-9 times). With improvements in the software and larger, faster machines becoming the status quo, this will no longer be a problem.

Another problem is that of maintaining current source code. Though installation disks are currently used, the programs are changing quickly and it is impractical to send floppy disks with updates to all the user sites. Instead, program code is uploaded to the mainframe, and made available for downloading. This has the drawback of making the user responsible for getting and keeping their local software current. A bulletin board on the mainframe informs users when and which programs have changed.

Access to the mainframe data is controlled by userid. Once that data is downloaded it is the user's responsibility to see to it that data is in a secure place. A public machine is no place for financial data. Right now, CUDA has no way to limit where that data is stored. Whenever the system is set up at a new site, file security, machine security, and the confidentiality of the material is stressed. The security of the information relies heavily on the attitude and precautions taken by the particular office. There have been no incidents to date, but we are vulnerable in this area. Programs for hard-disk locking and securing are being investigated. To date none appear worthwhile.

The synchronization of central systems can not be guaranteed unless the user is religious about downloading or locally entering all information. For example, if a user forgets a week's download then their local month-end bottom line will not match the central reports. Most departments do run the CUDA reports that match the central system to compare bottom lines before running their special local reports. CUDA is a local system, under departmental control, so the department has to take responsibility for the data in the system being current and correct.

The final problem was a bit of a surprise: free-lance sabotage. CUDA was not meant to do away with departments employing free-lance programmers. It was supposed to reduce the amount of redundant free-lance work that the university was contracting out. Non-Cornell programmers were told about the project and the source code was shared with them in the hopes that if they did customizing work, they would follow CUDA standards and integrate the work closely into the system. If the work was of general use it possibly would be incorporated into the general system to be used by other departments. Some outside programmers viewed the system as a threat and proceeded to criticize it to their departmental clients. Some of the heaviest criticism CUDA received was not from departmental users, but from outside programmers hired by the departments. Time will cancel any bad press they caused.

Successes

One of the major contributions of CUDA was the preparation of more flexible financial management reports. And if CUDA did not provide the needed report, the means to write a custom program. Many of the CUDA reports are table driven. The department sets up object codes, budget categories, etc. the most meaningful way for their department and the reports print, subtotal, extract, etc. that way. In addition to table definition by the departments, several local data fields were added to the files. These too are used to customize reports. Better reports, more in step with the particular department's needs means better use of financial information. This, in turn, should help the departments make better financial decisions.

The departments are more tolerant of the shortcomings of this system then any other I have worked on. I believe the reason for this is twofold. First, it is their system. From conception, many departmental managers were involved in the conceptual design, the technical specifications, the testing, and the documentation. They got to observe and have input into the development at every step. Computer staff worked as technical advisers and aides to create the system that business managers were imagining. If we went up a blind alley it was a user who sent us there. Secondly, the departments have been tolerant because we have built in the flexibility for growth and change. If additional reports or additional data fields are needed, users have been given the ability and right to add both to the system. The openendedness and control over the ultimate system has made the departments very satisfied.

Departments still have local information which the central system does not keep, nor will keep in the future. But with the downloading of data, the departments are not rekeying information and are more aware of how the central accounting system views their financial position. With the more flexible reporting, the additional local data fields and the downloaded data, departments are more and more regarding central accounting records as their records. They are more aware when central records are wrong and are more willing to take action to correct not only their local records, but also central records.

By-Products of the Project

A number of standardizations have occurred as a result of this project. DBASE has become the database for many administrative users at Cornell. DBASE may not be the best microcomputer database on the market, but having a standard makes support and future system compatibility possible. Standardization of financial software on the microcomputers is being achieved. Standardization of terminology and general knowledge of computers is helping us communicate with each other more effectively.

The local system is helping departmental administrators analyze and project their future needs. They are using the CUDA committee to communicate those needs back to the central administration. This is helping central administrative offices to become more responsive.

Finally, business managers in general are becoming more computer literate. With this exposure to microcomputers, many are branching out and automating other aspects of their operation.

Future

The pace of the CUDA project has not slowed down. Work continues on the other modules and incorporating enhancements to existing work. One of the major enhancements in progress is budget development software that allows different financial scenarios. Work already done by departmental programmers is being reviewed to see if it should be included in the system. When such software is found the programs are reviewed and modified, if necessary, to be compatible with the overall CUDA software and the corresponding central system (if one exists).

Other hardware/software options are continuously being investigated. With several companies coming out with DBASE or DBASE look-alike software for the Apple Macintosh, CUDA will hopefully be running on the Macintosh before the end of the year. In addition, FOXBASE has been found to run DBASE code with no modifications but 3-9 times faster than DBASE. We are in the process of converting CUDA users to FOXBASE.

In addition to microcomputers, larger offices have expressed an interest in CUDA on minicomputers. And finally the topic of uploading is being discussed for budget preparation. It is too early to say how that will develop.

Conclusions

This is clearly a large project with great opportunity for success and failure. Though possibility of failure is great, success will save the university a great deal. Microcomputers are now available to almost every department on campus. Not directing the use of these microcomputers in administration will cost in wasted administrative resources and poor management of departmental finances.

The benefits of this project are many. Some have to do with financial information and management and others have broader impact. It is difficult to describe, let alone calculate, all of the benefits derived from the project because financial information touches all areas of the university.

Downloading of data saves time for departments who were rekeying information from central system reports. In addition, the procedures and techniques developed for easy selection, downloading, and formatting of mainframe data can be applied to data other than financial.

Second is a structure which administrators can follow to become familiar with microcomputers and their use for things other then CUDA. CUDA has had an opportunity to set some standards for microcomputers in administrative use. For many administrators it will be a way to gain familiarity with microcomputers in their world and expand computer usage.

Microcomputer software and downloading will give offices a foundation to view central financial information without always accessing and paying for connect time on the mainframe. In addition, the provided programs will give examples and set programming standards to help the departments with their own custom programming.

Departments often complain that there are additional data elements that they would like to track. The data elements can be added to the local system and used in conjunction with downloaded data from the central system. Also departments complain of the timeliness of data. There will always be some time lag between a department's records and the central system. This cannot be helped, but with the local system, departments can flag information as pending until it clears. That way a record exists. Of course, having the data available on a microcomputer provides every department the opportunity to develop reports that fit their needs and allows a department to keep as many years of historic data as it wishes.

THE FOUR YEAR ID

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The development and the integration of a Student Records Data Base and the Human Resource Management System made it possible for LSU to provide current status information about students and employees to nearly every administrative department on campus. Online access eliminated the need to record status information i.e. major, year classification, fulltime/parttime status, etc. on the ID.

Having online access and adopting the ANSI standards for Bar Code and Magnetic Stripe technology on the same card made it possible for LSU to design one, permanent ID card for all known and anticipated ID card applications on campus. This discussion will highlight the design of the Four Year ID and its application for Football Ticketing, Food Service, SGA Elections, Library Circulation, Building Security, Time and Attendance Reporting and other applications.

INTRODUCTION

Louisiana State University, the flagship institution of the LSU System, was founded in 1860 as the Louisiana State Seminary of Learning and Military Academy in Pineville, Louisiana. The school was moved to Baton Rouge in 1869 and in 1870 was renamed Louisiana State University. LSU supports approximately 28,000 students with a faculty and staff of about 4,500.

The LSU administrative computing environment is served by an IBM 3084-QX mainframe. Most administrative applications have been developed using COBOL in conjuction with IBM's IMS DB/DC, an hierarchical data base/data communication product. Two very important applications utilizing this product are the Human Resource Management (HRM) system, a payroll/personnel data base, and the Student Records and Registration (SRR) system, a student information data base. Both were essential to the development of the Four-Year ID System. New development in these areas are continuing with design interfaces to DB2, IBM's relational data base management system.

The Four-Year ID system was designed using the IMS product and is integrated with the HRM and SRR systems. The Four-Year ID is a very important tool used throughout the campus environment. LSU has many departments which interface with or are interfaced by the Four-Year ID. This discussion will focus on the ID Office, Records and Registration, Personnel Office, Athletic Department, Student Government Association, Food Services, and the Library.

The integration of the Four-Year ID with the University information base creates a very useful and powerful asset. The key to integrating the ID into the mainframe environment is the automatic identification technology which allows data to be entered without keystrokes (keyless data entry). This "keyless access" to the information base can take many forms. One of these forms is the "machine readable" ID card.

For the purposes of this discussion a "machine readable" ID means any ID which contains information which can be read and interpreted by a machine without human intervention. There are currently three major types of media specifically designed for this purpose: OCR, bar code, and magnetic stripe. OCR (Optical Character Recognition) is a special type font designed to be read optically. A bar code is an array of rectangular marks and spaces in a predetermined pattern recognizable by a bar code scanner. Magnetic stripe is very similar to an 8 track tape in that the magnetic material can contain several tracks and each track can be encoded with information.

The purpose of an ID containing the machine readable media is to allow functions to be performed without having to manually keystroke the data. Therefore, the information encoded on the ID card must at least logically relate to the data being retrieved or updated. The index or key used most often by an institution will be the most likely candidate for use on the ID.

BACKGROUND

For many years LSU had issued ID's in the fall semester to enrolled students. This ID would be used throughout the academic year. In the succeeding fall semester a completely new ID would be constructed and issued. Every year nearly 30,000 IDs had to be produced. The cost of producing these ID's was significant. One of the reasons LSU had not gone to some type of career ID card is that the athletic department used the card for football admission. The ID card had a row of numbers along the bottom which were punched with a hole whenever a student picked up a football ticket. The hole signified that the student exercised his privilege for that particular game. By the end of the football season the ID was punched to pieces. Student Goverment elections and Homcomeing elections also required the row of numbers to indicate that a privilege had been exercised. In addition to this the Library punched the hollerith code into the card. The hollerith code was used by the library circulation system. After a year of this type of destructive encoding, the card became virtually useless. It was then replaced, and the process started over.

Another contributing factor involved a decision by the administration to automate many of the functions of the library. The library purchased a proprietary software package called NOTIS (Northwestern Online Totally Integrated Library System). NOTIS contains a library circulation module which requires that a patron have some form of machine readable identification. NOTIS recommends using one of the major bar code symbologies such as Code 3 of 9, Interleaved 2 of 5, or Codabar.

OBJECTIVES AND METHODOLOGY

In 1985, the Chancellor of the University decided it was time to modify its existing ID design and procedures. Therefore, university managers agreed to change and the following overall objectives were established:

- Produce the ID in "machine readable" form,
- Enable an individual to retain the ID throughout career,
- Provide a means for greater security and control,
- Utilize existing data currently residing on the mainframe.

The introduction of a new ID on campus can be a very involved logistical problem. The initial stages are very critical and cooperation across departmental boundaries is required. The mass production and distribution of the new ID must be carefully planned and executed. Proper controls must be exercised during the initial distribution in order to insure data integrity and security.

The coordination of a project like the Four-Year ID is very complicated because it crosses so many departmental boundaries. It requires a very strong sponsor. The Chancellor was the executive sponsor of the ID project. He set the objectives and delegated the responsiblity and authority to a project leader. With this type of backing, disputes between departments were easily diffused.

The development methodolgy used at LSU is a modified version of a method developed by IBM. There are six steps to this development process. Each step builds upon the previous one and allows management several checkpoints to review and consider the project as it develops.

1) Requirements Definition
The functions of the organization are analyzed and the scope of work is defined.

2) External Design
The Requirements Definition is used as a blueprint to develop the overall conceptual design of the system that will carry out the objectives of the scope.

3) Internal Design
The data base struture is defined and program specifications are prepared.

4) Program Development
The application programs are written and tested.

5) Demonstration and Installation
The users are trained and the application is implemented.

6) Maintenance
Continued analyst support for the lifetime of the system.

Most of the projects associated with the Four-Year ID have been completed within very short time frames. Unlike most development projects, which are strictly software projects that rely on existing hardware configurations, the Four-Year ID required extensive research into available automatic identification technology. Because of Louisiana purchasing laws, complex bid specifications had to be written. From the outset, it was decided that it would be expeditious to reveiw the available hardware/software at the same time the requirement definition and external design were being written. This analysis enabled the project leader an opportunity to prepare a cost/benefits proposal early in the development process.

SYSTEM FEATURES

There is a very strong correlation between the system objectives and the system features. The project, from the start had a very real purpose and direction.

LSU produces its own ID cards. This has proven to be very cost effective and expeditious. Cards are produced at registration, which is a mass production type process, and again during the semester to replace lost IDs, new employees, etc. LSU issues no temporary cards.

The process used at registration is for new students. Prior to registration, a label is printed for every eligible student. The data label is 1-1/2 inches tall and 2 inches wide. The label is then affixed to a "carrier card," which is a fan folded card stock with a blank label. The label is printed with the students name, student id number, and bar code representation of the id number. The label information is obtained from the Student Records data base used to produce registration packets. The label is printed on a Printronix 4160. The printer is connected to the mainframe via IBM 3274 control unit and QMS wedgebox. If a student has registered late or has lost his ID, the label is produced at registration using the Printronix printer with a PC as the host. During the semester, ID's are produced online from the IMS ID update program. The Printronix printer is used in this configuration also.

At the present time the carrier card is stuffed in the student packets which are picked up at registration. The new students need to bring the carrier card and fee bill to the ID station at registration to have their ID made. The ID station takes the student's picture, peels off the label from the carrier card and affixes it to the ID chip, then they die cut the picture, place it in the ID chip cutout, the student sign's the card, and then the card is run through a laminator. The chip is a polyester laminate which has a cutout for the picture, and the magnetic stripe is affixed to the back layer of the laminate. The ID cards are electronically validated by updating the ID data base with an interface program to the Student Records data base.

During the Spring of 1989 the old auditorium registration procedures will be replaced by the Telephone Registration system. The carrier card will still be used, but it will not be stuffed into the packet. Procedures are defined which will allow the new student an opportunity to have their ID card made at the Student Union, a central geographic location. The student will be required to present the registration confirmation document. The Telephone Registration system is another major step for the University. It demonstrates the advantage of integrated systems.

The Four-Year ID is the only ID card produced and used on campus. It is used for all applications which require some type of identification. One set of data is maintained on these IDs for each individual who has been issued an ID card.

The ID data base contains a segment (or record) for each ID card issued. It eliminates the old cumbersome manual card file that was kept to verify that a student was issued an ID card. The major relationship between systems is the ID number symbolized by the bar code. With this number any data contained in the Student Records data base or Human Resource Management data base can be accessed through the use of the ID card.

The ID number is composed of the student or employee number, a type code, a sequence number, and a check digit. The type code is a one digit identifier between employee, students, and other defined groups. The sequence number is a one digit code identifying the number of ID's an individual has had. The sequence number is very important because it uniquely identifies each ID. The check digit is used to assure data integrity.

The Four-Year ID data base is an IBM IMS DB/DC data base. The data contained in this file can be accessed by either online or batch programs. The LSU ID office has the capability to online update the ID data base. This enables all applications using the ID data to obtain the latest information. It also allows the ID office to print the ID labels from the same online program. When a new ID is produced the data base is automatically updated. The data is always available for immediate access and the information is current.

The most important feature of the Four-Year ID card is its use of two types of electronic identification technology - bar code and magnetic stripe. The bar code has a high read rate (99%), can be read from a distance, is inexpensive to produce on demand, and its low error rate compared to other means of data entry is significant. The magnetic stripe is 5/8 inch, and can contain all three ANSI defined tracks. The magnetic stripe is able to be encoded with information in a high density and the data on the stripe can be altered.

The card size is important because it accommodates the industry standard specifications on card reader hardware. The majority of automated teller machines, security access devices and various data collection devices require that the card meet ANSI credit card size specifications.

The physical properties of the Four-Year ID are all defined by the American National Standards Institute (ANSI). The card is credit card size, the dimensions (length, width, and thickness) are defined by the Institute within tight tolerances. The size of the magnetic stripe, its location on the card, the location of the tracks on the magnetic stripe, the format and location of the data on the tracks, and technical encoding specifications are all defined by the ANSI publications. The bar code symbology, Interleaved 2 of 5, used by the Four-Year ID is also covered by Automatic Identification Manufacturer's specifications as well as the ANSI standards.

The use of ANSI standards is extremely important to the writing of bid specifications for the procurement of equipment. Because most manufacturers design their equipment around the ANSI standards, it is advantageous to design the ID card to work with standard equipment. Another important aspect is that the specifications are so tight that it is very unlikely that a manufacturer will bid a piece of equipment that does not meet the specifications.

Information about the ID is stored for as long as necessary. The fields which deal with dates of issuance, last update, and expiration date are very important and are retained for the conceivable life of the ID card, which is determined only by the proper care of the card. Of course, the IMS data base must be purged periodically.

The ID data base is a separate and distinct entity but it accesses several other data bases in its day to day operations. This information from other data bases is used to determine privileges, elgibility, and status. Redundancy is reduced through this means. Other applications utilize the information stored in the ID data base. These interfaces are very important and add a measure of security which were not previously available.

INTERFACES

The integrated application computing environment at LSU promotes the usefulness of the Four-Year ID system. The ID system interfaces with many of these systems. The ID data base was designed to interface with every anticipated application. The source of this ability is the coded information on the card. The information represents the index configuration used in all of our data base structures.

The Registration interface is very simple in principle. ID data cards are produced for eligible students from registration system information. At registration time, ID cards are constructed and the information is loaded to the ID data base. Immediately after walk-thru registration, information from the registration system is used to electronically validate the ID data base.

Information from the Student Records data base is used in many phases of the ID system. Full/part time status with respect to hours carried, athletic privileges, and SGA voting privileges are updated constantly. For many of the subsystems this information is captured online. The ID update screen used by the ID office contains online information from the Student Records system which is used to determine eligibility and status.

Employee (Faculty/Staff) information is captured by the ID system online for the verification and production of employee ID's. There is current development work in progress which will utilize the HRM data base and the ID data base in conjuction with the Four-Year ID for employee time and attendance tracking.

An unique interface came about as the result of automating the policies and procedures associated with the ID hole punching by the LSU Athletic Department. The interface was required to adhere to the following objectives:

- Allow students to purchase season tickets,
- Allow students to select the game(s) desired,
- Allow students who did not receive season tickets to purchase the remaining tickets,
- Check the status of the students at the student entrance gates at game time to insure only full-time students are entering.

The Season Ticket System required a combination of several different technologies. For example, a ticket application is filled out on optical scanning sheets. These sheets are read and data sets are built. Student elgibility is checked via inquiry to the Student Records Data Base and priorities are established based on LSU hours earned. Seats are matched to students and a tape is prepared which is sent to a ticket printing vendor and tickets are produced. The information used to create the ticket tape is also used to produce a file of the cost of the individual student season ticket packages. This file is downloaded to an IBM PC/AT micro computer and is used in the purchase/pickup operation.

The purchase/pickup operation utilizes bar code technology. When a student purchases his ticket package, the ID card is scanned and a flag is set indicating that student paid for the ticket package. This information serves two purposes:

- Accounting information is recorded for audit and balancing purposes,
- Ticket information is recorded to insure students are only able to exercise this privilege once.

Remaining tickets are sold on a first come basis. Student eligibility is checked online under IMS using laser wedge readers as input devices and this ticket information is stored along with previous season ticket information.

The game admission operation at the student football gates utilizes bar code technology. Student status is obtained from the Student Records Data Base and downloaded to an IBM PC/AT at the stadium. Bar code readers are attached to the PC/AT and student status information is transmitted to the reader display.

The SGA Voting System is very similar to the online Ticket System. Each voting station has a terminal connected to the mainframe and each teminal has a bar code wedge reader attached to it. When a student requests a ballot the ID card is scanned. The scan invokes an IMS online program which checks the eligibility of the student and flags the student as having voted. Any subsequent scan would reveal that the student has already voted.

The Food Service system is a very sophisticated meal plan access system. It utilizes the magnetic stripe for its cafeteria access method. The system is a hybrid between a micro computer and the mainframe. The CBORD software/hardware package contains all of the communication and access programs necessary to control admission to the cafeterias. The mainframe is used to load the meal plan access master file at the beginning of the semester with eligible students and their biographical information. It is also used to store the daily transactions for historical reporting. All of the communication to the mainframe is accomplished through 3270 emulation protocol. Communication from the PC to the cafeterias is performed with line bridge/amplifiers and modems. Modems are built in to the magnetic stripe reader hardware.

The NOTIS (Northwestern Online Totally Integrated Library System) package purchased by the University has been implemented with much success. Before NOTIS, library circulation was a problem. The old ID's were void of any type of security and the check out procedure was time consuming and cumbersome. The NOTIS system is a bar code system which utilizes the Student Records, HRM, and ID data bases to build and maintain the Patron data base. The Four Year ID is scanned to pick up the patron ID number and is associated with circulating books. The Patron data base is updated weekly during the semester, but can be updated on demand.

SYSTEM BENEFITS

The introduction of the Four-Year ID has had a significant impact on the University environment. The benefits are many as it has allowed the implementation of innovative applications which have benefited both the students and administration.

Because the card is not tied to the status of the individual it need not be replaced each time the individual's status changes. This fact eliminates the long lines previously associated with the mass production problem of redistributing ID's each year. The machine read capabilities allow applications to accurately and easily process the card for various fuctions.

The use of the ID sequence number gives a measure of security not known before. It uniquely identifies each ID. When an ID is lost, the ID Office is notified and the lost ID can be invalidated immediately through the online update screen. All applications which interface with the ID system at that point know the status of that ID. This prevents abuse of the ID in those applications such as Library circulation, Football ticketing, SGA elections, or any system that interfaces with the ID data base. A hard copy of the carrier card is kept which validates the fact that the individual was issued an ID card. The ability to query and update the ID data base in an online mode and receive the answer immediately gives the user the latest verifiable information.

The Four-Year ID is not tied to any particular system or individual status. Its key is the same key on the data base which allows it to be used by any application. For low cost operations there is still a visual validation sticker applied to the ID card each semester. An individual's status can be verified online and through the visual validation sticker. The computer validation is done at registration each year.

The ANSI standards used allow for the continued growth and built-in flexibility of the Four-Year ID. The University will continue to take advantage of the new technology adhering to the ANSI standards, build on them, and use them in the future as we embark on innovative applications.

CURRENT DEVELOPMENT ACTIVITY

Time and attendance is probably the next major development interface. The hardware and software to integrate the Four-Year ID into the Payroll System is available. The requirements structure is being defined at this very moment. Another proposal being prepared right now is for restricted building access. It will use the magnetic stripe and a personal identification number (PIN) with a stand alone reader/keypad. Departments will code their own restrictions. Other applications such as check cashing and debit card use are feasible and the Student Union is interested in both of these concepts, but resources have not been assigned to these projects. The Student Health Service is investigating the use of the Four-Year ID card in conjuction with a medical records system.

CONCLUSION

The implementation of the Four-Year ID has been very successful. It has generated enthusiasm for many other applications and continues to do so. The concept of the Four-Year ID being a "career" type card has allowed the University to build upon the original design. The importance of meeting the original objectives has positioned the University to take advantage of an excellent tool that is gaining momentum and importance in the campus environment.

The Development of a Successful Microcomputer Network Operation: Winthrop College's Novell NetWare LAN's

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ABSTRACT

Implementation of a high-speed, Local Area Network (LAN) can provide the educator with a very valuable teaching tool for information processing. However, there are many pitfalls and subtle, but significant ramifications inherent in the selection, installation, and implementation of such a system. Experience is an excellent teacher when it comes to networking microcomputers and Winthrop College has had its share of that form of education. The Academic Computer Center currently operates three networked, instructional laboratories with over 85 nodes.

This presentation will include our reasons for choosing a LAN- type system, development of specifications and selection of a particular type of LAN. The technical aspects of installation and implementation will be reviewed. Recommendations from experience and statistics on usage will be discussed with some comments on our plans.

Microcomputers are pervasive not only in government and industry, but also in colleges and universities. The impact of this segment of the computer revolution is changing the educational process with the aim of integrating computers into every part of the system. The intent is not only to provide for a student's smooth transition to professional practice, but to enhance the student's learning process in all areas of education.

Winthrop College has undertaken this challenge of integrating computers into the educational process with the implementation of several very successful LAN applications. The Southern Business Administration Association has presented Winthrop's SBA an honorable mention award for the project "An Innovative Approach to the Acquisition and Integration of Microcomputers into a Business School Curriculum." This report will review some of the major steps taken in our effort to computerize the curricula at Winthrop College.

Evaluation and Selection

Why a LAN?

The Department of Computer Science and the Academic Computer Center at Winthrop College are organizationally under the School of Business Administration. Two faculty committees, one from the Computer Science department, the other from business departments, were formed to evaluate how best to use current tools of information technology in their respective curricula. Two members of the Academic Computer Center served on both committees for technical support and coordination purposes.

The Computer Science committee focused primarily on its commitment to teaching computer literacy to non-majors and beginning computer science majors. The committee representing business departments chose to be as diverse as possible in their considerations by including their entire curriculum.

Of the many facets of computer literacy education, two items were common to the faculty committees' deliberations. These were to provide the students with the ability:

1. to describe the components, operation, and uses of a computer, and
2. to use major application software effectively in problem solving.

Several other aspects of computer literacy were determined, but not common between computer science and business. As an example, computer science wished to teach structured programming to its majors. These additional requirements posed no difficulty in establishing our criteria for selection. However, it was important that the LANs selected be able to execute all functions designated by the respective committees.

Micro-based system laboratories with major application software in database, spreadsheet, graphics, and word-processing were determined to be the most effective vehicle to support these objectives. There were to be three laboratories, two for business education and one for computer science. Two laboratories, one business and one computer science, were designed for scheduled classroom use. Each of the two labs included an instructor's workstation and color video projector monitor. The third laboratory was planed as an open, walk-in facility with no scheduled classroom use.

Based on the nature of the software selected and on the course laboratory structure, several major characteristics of the microcomputer laboratory workstations and the laboratory environment were determined.

The microcomputers were:

- to be complete computer systems with such features as maximum memory and processor speed to handle major software applications.
- to have both parallel and serial communications, enhanced graphics capabilities and high resolution color monitors.
- to be able to share several expensive resources such as hard-disk storage, high-speed printers (laser and dot matrix), and plotters.

The micro-based system laboratory was to have:

- a very fast response time in downloading major application software packages.
- a menu-driven turnkey system with security provisions.
- the capability of quickly spooling printer files to a large buffer where they could queue to high speed printers.
- the ability to send electronic messages, transfer files, and protect software and data at various levels.

The above features describe the automation of "internal" data communications within a cluster of microcomputer workstations. These features identify what is often termed "local area networking". We determined that this type of solution best met our needs in teaching computer literacy.

What type of LAN?

Local area networks are most often classified by bandwidth, topology, and protocol. A brief description of each of these network types is :

- **Bandwidth** - the data path or channel capacity of a network. This is a measure of the network's ability to transmit and receive information.
- **Topology** - the physical network structure. Network topology describes the arrangement by which the workstations are physically and electrically connected. The star, ring, tree, and bus are four geometrical structures most commonly employed. There are physical (hardware structure) and logical (signal paths) approaches to these topologies where combinations of the star, ring and bus are possible.
- **Protocol** - the rules by which data communications are controlled. These rules are primarily communications standards by which information is transmitted and received within and across network boundaries. Protocols include data communications procedures and conventions such the as International Standards Organization (ISO) seven layered model for communications standards and methods of data packet transmission such as Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA), Collision Detection (CSMA/CD) and token passing.

There exists a variety of LAN technologies from which to choose. Three fundamental network technologies with several of their associated characteristics are:

- **PBX or Private Branch eXchange** - mostly uses in-place twisted-pair wiring, can support star or tree topology, and can provide for data, integrated data and voice, and facsimile transmission.
- **Baseband** - uses twisted pair wiring or coaxial cable, will support a star, ring or bus topology and can provide for data, voice, and digital facsimile transmission.
- **Broadband** - uses coaxial or fiber optic cable, will support a tree or bus type topology and can provide for video, voice, data, and security device transmission.

The basic characteristics of our laboratories were 25 to 35 microcomputers in local clusters, a need for only data transmission, high data transmission rates, a non-complex installation, and low cost. The baseband technology appeared to meet these features most effectively. Some major LAN's which use the baseband technology are Xerox's EtherNet, Datapoint's ARC, Digital Equipment's 3Com, IBM's PC Network, Quadram's QuadNet IX, and Corvus's OmniNet.

Which LAN?

The type of microcomputer and LAN configuration was based entirely on the application software and laboratory structure. The software and laboratory structure was, in turn, based on the aims of the computer literacy courses as determined by faculty committee consensus.

Our laboratories, unlike most office environments, involve a large number of people "downloading" the same application software simultaneously. At the end of class sessions there is a large queue of tasks at the printers. The Novell system, with its combination token passing, ring-of-stars design and system software for handling file-server I/O, fit this requirement very well.

A token passing protocol is more efficient than CSMA/CA and CSMA/CD with increasing numbers of workstations added to the network. On the other hand, token passing, based on a ring structure topology, can be a problem. If a node were to fail, the entire network would be halted. Novell has worked around this by providing a star-shaped ring design whereby workstations are connected in a star fashion via wire centers. System integrity is maintained when a workstation fails or is disconnected.

Also, the NetWare's method of handling file-server I/O enhances system performance under heavy load. NetWare's hashing of directories reduces file look-up time, disk caching for often used files improves access time, and use of the position of disk head to influence the ordering of disk read/write requests reduces seek times.

A limited time schedule and budget prevented us from evaluating most major LAN systems. Several vendors had announced systems which were not available at the time for demonstration. While we were receptive to a vendor's literature and presentations, we held very dearly to the tenet that real-time demonstrations of the network performance with our major software and selected workstations was essential.

With these essential criteria in mind, we selected:

- network:
  Quadram's QuadNet IX
  Novell Advanced NetWare/286
- fileserver:
  NCR PC-8 AT microcomputer (2048 Kb)
  30 Mb Fixed Disk
- workstations:
  Leading Edge Model-D microcomputers (640 Kb)
  STB enhanced graphics cards
  Amdek 722 high resolution color monitors
- printers,main:
  Okidata 2410's

Procurement

A specification fact sheet

We set up specification sheets for our microcomputer workstations, file servers and for our network. A sample specification sheet for the Quadnet IX system is provided in Appendix I.

Provisions for support:

The diversity and complexity of current, local area networks require a level of expertise not available in many institutions. Experienced help is initially required for consulting and educational support.

An agreement or contract was negotiated for support in the installation and implementation of the network with the following areas addressed:

- background and essential conditions of the project
- scope-of-work with specific directions for the consultants.
- consultant's responsibilities (methodology, work schedule, provisions for education on network).
- college's responsibilities (access to data, personnel, facilities).
- ownership of work products (property of the College).
- payment (work accomplished, verification, schedules).

Several vendors bid on the consulting contract. We were fortunate to have the vendor of the LAN system successfully bid on the consulting and education contract. Having the consulting service, hardware, and software from the same vendor proved very valuable. This gave us a common access to assorted experts and avoided conflicts resulting from vendor quarrels over responsibility for problems.

Installation

Hardware and topology:

The major network hardware consisted of file servers, workstations (microcomputers), cables, streaming backup tape and Uninterruptible Power Supplies (UPS's). An abbreviated listing of installed hardware includes:

- network file server
  - processor (80286)
  - system console (monochrome)
  - disk subsystem(s) (30 Mb)
  - printer I/O (serial/parallel)
  - expanded memory (2 Mb)
  - network interface card
  - software key card
  - Uninterruptible Power Supply (UPS)
- network workstation (PC)
  - processor (8088, ipx80 processor family)
  - expanded memory (640kb)
  - network interface card
- network cables
  - type I or type VI (shielded dual twisted pair)
  - wire center
- streaming backup tape system (Alloy)

A star-shaped-ring topology determined the electrical configuration of the laboratory with the wire centers acting as "hubs" to the workstation. We contracted out for electrical work in our laboratories with our systems engineer overseeing the project. We also provided for support from a network consultant in the installation and implementation of the system. Our systems engineer was responsible for the major portion of the software installation, system implementation, and its maintenance.

The biggest problem we encountered in the installation was that resulting from the cable connections. If cable strands were broken or frayed such that a full wire connection was not made, intermittent problems would occur and the network would perform erratically. All connections had to be true and firm. Also, we placed all cable into secured conduit or trays so that movement or inadvertent bumping would not dislodge it.

System software

Systems software was installed by our systems engineer. Consultants were brought in to fine tune the network parameters. They also made valuable suggestions on adjusting parameters for our custom applications. System software consisted of Novell Advanced NetWare/286 with the following features:

- supports up to three parallel and two serial network printers.
- token passing, updates token list for new users automatically.

- security system with multilevel protection for both users and files.
- memory-to-memory transfer of data.
- allows connection for up to 255 nodes in a "ring-of- stars."

Menu and security profiles must be established and installed for proper use of the applications systems in the student laboratory environment.

Application software

For the Fall '87 semester, we had 20 software packages on the LAN's and 31 courses formally using the laboratories. Table 1 provides some information on the kinds of application software used by the academic departments. Software applications are categorized as spreadsheet/graphics (SSG), database management (DBM), word-processing (WP), business/business games (BBG), statistics/graphics (STG), compilers/interpreters (CI), and communications (COMM). Some overlap exists in the specified categories. As an example, several of the software packages listed in the spreadsheet category are template-oriented with direct business applications. Other, miscellaneous software items are not listed. Major academic departments are Management (MGMT); Marketing, Economics, and Fashion Merchandising (MAR/ECO); Accounting and Finance (ACT/FIN); and Computer Science and Quantitative Methods (CSC/QM). Each entry in the table represents the number of software packages used by category and department.

Table 1

Software packages by academic department and category

SOFTWARE CATEGORY	ACADEMIC DEPARTMENT MGMT	MAR/ECO	ACT/FIN	CSC/QM
SSG	1	1	5	1
DBM	1	1		1
WP	1	1	1	1
BBG	6	4		1
STG		1		1
CI	1			3
COMM				1

Data in Table 1 does not provide information on the extent of usage of any particular software item. We hope to quantify such information with the use of a LAN management accounting package. From general observation, spreadsheet (LOTUS 1-2-3)[1] and word-processing (WS2000)[2] are two of the most used software packages on our systems.

Implementation

Training for systems and applications support is crucial for the proper implementation of the LAN laboratories. In our agreement with the LAN consultants, we provided for twenty hours of on-site educational seminars. These seminars were provided for computer center personnel and key faculty in the business and computer science areas. The faculty then held classes for faculty and staff end users and for student tutors.

Problems occurred, but were not so catastrophic. The education and training provided seems to have made them more manageable than they might have been otherwise. Education and training should be a regularly scheduled exercise.

Use of the LAN's

Policies and procedures

Of critical importance in the use of the LAN's is the establishment of guidelines and rules. As is most often the case, those not technically responsible are less concerned than computer center personnel over security and maintenance time and press for more open access. However, a balance must be maintained between security provisions, maintenance time, and open access.

The academic computer center is responsible for the physical inventory, systems, and operations support of the LAN's. The Associate Dean of the School of Business schedules the use of the labs and decides which applications are placed on the systems. In this manner, the academic computer center is removed from making decisions on the relative merit of academic applications.

Each LAN application must have its own set of guidelines. Responsibilities for the administrative and technical management of the center should be clearly defined.

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[1] Lotus 1-2-3 is a registered trademark of Lotus Development Corportation, Cambridge, MA

[2] WS2000 is a registered trademark MicroPro International Corporation, San Rafael, CA.

Usage statistics

We are preparing to evaluate several accounting packages that can be installed on the LAN's that will allow us to keep accurate statistics on usage. We have recorded manually some data on laboratory usage by having student operators make head-counts on a hourly basis in walk-in laboratories (WI) and by recording course enrollments for classes regularly scheduled in instructional laboratories (IL). While the data is at best "rough", it does provide us with an approximate measure of usage. All data has been reduced to student-hours per laboratory per semester (Table 2). Fall and spring semesters are 15 weeks in length, summer session is 10 weeks.

Table 2

Student-hours usage of LAN laboratories

	Business		Computer Science		
Semester	Lab 1 (WI) 28 wkstns	Lab 2 (IN) 28 wkstns	Lab 3 (WI) 29 wkstns *	Lab 3 (IN)	Totals
Fall '86	9,831	10,000		13,789	33,620
Spring '87	12,915	8,477		11,676	33,068
Summer '87	3,318 **	2,692		50	6,060
Fall '87	9,291	7,512	5,101	12,927	34,831

* other workstations (wkstns) are connected to file servers, but not located in the labs. These are not included in lab counts.

** estimated value based on relative walk-in, instructional lab use.

Plans for future development

Use of the LAN's has stimulated both interest in and use of computers. For the present, we have also experienced a decrease in the number of accounts on our host system resulting from a shift of basic computer work to the LAN's. Host system usage, however, is increasing by way of more sophisticated applications not available on the microcomputers. Juniors and seniors, without structured exposure to the microcomputer laboratories, requested the opportunity to retake a computer literacy course under the current regimen. A 200 level course using the LAN's was developed for these people.

Faculty and student usage of the LAN's has increased their productivity in the areas of class administration, assignments, research projects, papers, and theses.

There is a user demand for enhanced and additional facilities. Our plans are to:

- link the three LAN laboratories via fiber optic cable and bridges.
- provide gateways to host processors.
- establish more laboratories.

In conclusion, both the users and support people are very satisfied with the general performance of our LAN's. This is especially apparent from their requests for more access to the systems including office connections to the LAN's. We owe the success of these laboratories primarily to faculty/staff involvement at the initial stages of course and laboratory design, system-evaluation that included site demonstrations, and adequate provisions for consulting and educational support.

Appendix I

Local Area Network: QuadNET IX

Marked by:

Quadram Corporation
4357 Park Drive
Norcross, GA 30093
(404) 923-6666

Retail Prices:

Starter Kit	N/A
Workstation	$795.00
Server Station	$1,495.00
Dedicated Server	N/A
Coaxial Cable (per foot)	$.95
Connector (4 Stations)	$95.00
Repeater	N/A
Four Station Configuration	$9,265.00

Hardware Capabilities:

Number of Servers	1
Number of Workstations	256
Server Type	IBM/AT

Memory Requirements:	[Min/Max]
Dedicated Server	256/16Mb
XT Server	356/640K
Workstation	128/640K

Peripherals Supported:

Serial Printer	YES 2
Parallel Printers	YES 3
Plotters	YES
Hard Disk	YES
Tape Drive	NO
Other Mass Storage	NO
Modems	NO
RAM Disks	NO
Other Communications	NO
Other	NO

Backup Support:

Vendor Supplied	YES
Disk	YES
Global	YES
Other	NO

Network Description:	Token Passing
Architecture	Ring/Star
Type	Baseband
Speed	9.92Mbps
Server Type	XT

Security Provided:

Logon ID	YES
File Passwords	NO
File Protection	YES
Record Protection	YES

Diagnostic Supported:

Cable	NO
Server	NO
Workstation	NO
Network/Station	NO
Auto ReRoute	NO

Software Capabilities:

Operation System:	PC-DOS
Disk Caching	YES
RAM Disk Support	NO
Systems Manager	YES
Other	YES

Application Software Included:

Electronic Mail	YES
Chat	NO
Utilities	YES
RAM Disk	NO
Other	YES

Print Spooler Features:

Variable Buffer	YES
Disk-Based	YES
Change Paper	YES
Printer Commands	YES
Multiple Copies	YES
Queue Inquiry	YES
Purge Queue	YES

BIBLIOGRAPHY

Information on LAN's:

Bolton, Tony. "Local Area Networks: They're not all alike." The Office, April 1985, pp. 68-71.

Buckland, John A. "The Information Center Institute checklist for Local Area Networks.", Information Center, December 1986, pp. 47-48.

Dickey, Sam. "LAN landscape: Is success on the horizon ?", Today's Office, November 1987, pp. 15-22.

Durr, M. Networking IBM PC's: A Practical Guide, Indiana: Que Corporation, 1984.

Feldman, F. "Local Area Networks help machines to communicate.", The Office, April 1985, pp. 128-130.

Hald, Alan and Grant, Bruce "LAN mines for the unwary.", Information Center, December 1986, pp. 38-39.

Jordan, Larry. E. and Churchill, Bruce, Communications and networking for the IBM PC, Maryland: Rober J. Brady Company, 1983.

Levin, David. "Evaluating generic Local Area Network technologies.", Small Systems World, January 1985, pp 15-16,41.

Ruef, A. "Cost benefits aren't the best LAN justification.", PC Week, 3 February 1987, p. c/31.

Vacca, John R. "The network mess.", Information Center, December 1986, pp. 30-40.

LAN Magazine, 12 West 21 Street, New York, NY 10010 (published monthly).

Information on Quadnet IX and NetWare:

Cowart, R., Kanzler, S., and Rosenthal, S. "Quadnet IX", PC Magazine, 5 February 1985.

Krumrey, A. "NetWare in control", PC Tech Journal, November 1985, pp. 103-119.

Information on computer literacy:

Friedman, E.A. "The wired university", IEEE Spectrum, November 1984, pp. 115-120.

Golden, R.E. "Caution and skepticism are needed on the road to computer literacy", The Chronicle of Higher Education, 7 December 1983, p. 80.

Goleman, D. "The Electronic Rorschach", Psychology Today, February 1983, pp. 38-43.

Price, Barbara A., Archer, Clark B., and Moressi, William J. "A successful approach to computer literacy", (accepted for publication), ACM SIGCSE Bulletin.

Render, B. and Stair, Jr., R.M. "Managing the microcomputer movement on campus", Information & Management, North-Holland: Elsevier Science Publishers 8(1985), pp. 253-259.

Van Dyke, Carolyn. "Taking Computer Literacy Literally", Communications of the ACM, May 1987, pp. 366-373.

Changing Administrative Database Philosophy; Network to Relational

Becky King

Baylor University
Waco, Texas

This last year was the beginning of a major transitional period for Baylor University Administrative Computing. Not the least of the changes was that of acquiring IBM's relational DB2 as the database for all future development. This required a complete rethinking of application design and integration philosophy because all existing database systems employed a CODASYL network database. This paper discusses the background and implications of this major software change as well as lessons learned through the first year of implementation of SQL-based relational systems.

Changing Administrative Database Philosophy; Network to Relational

Baylor University, located in Waco, Texas, is the oldest university in continuing existence in Texas. The approximately 11,500 students are spread throughout the College of Arts and Sciences and the Schools of Business, Education, Law, Music, and Graduate Studies in Waco and the School of Nursing in Dallas. There are also affiliated graduate programs with the U.S. Army Academy of Health Sciences in San Antonio. Baylor is under the patronage and general direction of the Baptist General Convention of Texas and its mission, as stated by President Herbert H. Reynolds, is "to be an institution of higher learning where education may be gained under Christian influences and ideals". Dr. Reynolds has defined several major goals for the late twentieth century, one of which is to "achieve a state of computer literacy within the faculty and student body". This charge from the top influences all systems development and implementation. It lends support to the effort to integrate and enhance the entire database of University information.

Baylor Computing Environment

The Center for Computing and Information Systems, under the leadership of the Director of Information Systems, is composed of the Academic Computing Section, the Administrative Computing Section, the Communications Section, the Office Automation Section, and the Microcomputer Store. The Administrative Section includes two associate directors, two systems programmers, a database programming coordinator, four programmer/analysts, four student programmers, and a microcomputer support person as well as operations and production services personnel. Administrative computing has been handled by a Honeywell computer since 1968. Through several hardware upgrades the University has been well-served by this environment, developing many inhouse systems including a respected on-line registration system. Several years ago a commitment to the database philosophy for new software development was made, and implementation of Human Resources and Alumni/Development Systems followed using Honeywell's IDS-II network database management system. However, as the educational arena became more competitive, the funding for new staff tightened, the demands of more computer-literate clients multiplied, and the number of third party software packages available increased dramatically, the administration became convinced it was time to re-examine the administrative computing situation and the philosophy of developing all software inhouse.

After much study and work by various appointed committees composed of faculty and staff, several major hardware and software decisions were made in 1986 by the administration and Board of Trustees. An IBM 4381 was purchased and MVS/XA was chosen as the operating system. The VSAM version of Information Associates' Student Information System was also purchased and implementation begun. The Computer Associates Unicenter software support products were acquired. And finally, IBM's relational DB2 was chosen as the database to be used for all major system development. These critical decisions forced the Administrative Section into a difficult conversion situation. The influx of new products also compelled the staff to learn many new tools and concepts while continuing support of current Honeywell systems. However, everyone involved, while sobered by the work ahead, believes the results will put Baylor in position to become a leader in university administrative computing.

DBMS Decision

In considering the database selection, we remained committed to the database approach to systems development. Our current database systems are successes, and we are sold on the integration of data and the tools that come with a DBMS. Because the IA Student Information System had been chosen, we were primarily looking at database management systems compatible with that software. At the time IA had versions running under ADABASE, IDMS, and VSAM on the IBM, but we learned of plans to introduce an SQL version in the future. This information, along with some questions about the current IA database versions of the SIS software, led us to look very carefully at DB2 and ultimately select it. Some of the major reasons for this decision were:

- We were attracted to the relational technology for its flexibility. The ability to add elements to tables and define new tables and indexes fairly simply was a very big plus. Also, we felt system development in general would be a faster process with a relational DBMS.

- Relational systems are the easiest to understand. The terminology is simple. Clients can more easily grasp the concepts of tables, rows, and columns than records and sets.

- SQL is becoming a standard. Many vendor software products now have SQL versions. Therefore, any tools we might want to purchase in the future would be available.

- Finally, IBM is touting DB2 as its database of the future. And DB2 has been well received by critics that rarely laud

IBM undertakings. This reinforced our feelings that most products available in the future will work with DB2. Also, we liked having the same vendor for hardware and software.

Implementing Relational Technology

After our DBMS was chosen, we had to decide what to do with it. What would be our first DB2 application? We selected the Student Payroll System, a relatively small system with a limited group of primary users. The current system was a completely batch one written in COBOL-68 which caused headaches each month for all involved with it. The programs had been patched for years and produced inconsistent and unpredictable results. And because it had to interface with the newly purchased Student Information System, Student Payroll would need to be one of the first systems converted to the IBM anyway. So not only did we have a smaller system on which to learn about DB2, but we could also improve our service to the student body by rewriting a poor system which impacted many of them.

We then began reading manuals - many, many manuals. We invested in two IBM DB2 classes, one on database administration and one on system administration. These were especially helpful in learning DB2 terminology and design techniques for improved performance. Because SQL is so simple to learn and because our programmer/analysts were already familiar with a much more complex data manipulation language (DML), we decided against programming classes for the staff. We have been happy with this decision. Our people have picked up SQL and its use with COBOL very quickly.

Designing the Student Payroll relational database was a new and exciting task. The major process was defining all the data elements and normalizing them into tables. The resultant database has nine tables and nine indexes. The student I.D. number is repeated in all but one table and the student account number is repeated in several. This repetition of key fields without referential integrity in place is a troubling aspect of relational design in DB2. However, the design process itself is greatly simplified by having to consider only one data structure. In our database, after consultation with IBM and other DB2 users, we chose to define one table per tablespace and to do our own VSAM management rather than let DB2 handle it through its storage groups. The consensus seemed to be that these two choices were the most efficient and provided us the most control.

COBOL programming in SQL, while fairly simple to master, did require some adjustments and initial study. The major differences we have found include:

- Rather than accessing the information a record at a time within a program, a "set" of data is retrieved based on the SQL requirements coded. Then a cursor is used to fetch succeeding rows from this "set". But because a knowledge of record and set structures is not necessary, our staff found this much easier to use than the CODASYL DML. For example, the FIND statment in IDS-II has eight very different formats to be used depending on how the data is to be accessed.

- The size of the source listing is tremendously increased by the lines generated by SQL includes and calls. This makes the listing harder to read.

- To be made ready to execute, an SQL program must be run through two additional steps. Before the compile, a DB2 precompile must be done. This phase does some editing of SQL statments and produces a database request module. The second additional step is the bind step which produces an application plan used to allocate DB2 resources and support SQL requests during execution. Therefore the process of creating an executable module takes somewhat longer than with non-DB2 programs.

- Within an SQL statement field names cannot be referenced which are part of copy members to be copied into the program. These fields are not copied into the source until the compile step. Therefore, when the precompiler is verifying the SQL syntax, those field names are undefined and result in error condition codes.

- Special programming considerations are required in our network system when enlarging variable length fields. If a modify return code indicates there was not enough room on the page for the extra data, the record containing the field must be deleted and re-added by the program. In DB2, the system will move the enlarged row to the nearest page with sufficient free space and set up a pointer in the old position. This simplifies programming but does not relieve the need for periodic data reorganizations.

The design and programming on the new Student Payroll System went very well. It consists of 23 batch programs and 22 CICS programs. We had originally planned to go "live" with the first payroll of the fall semester. However, we switched over to the IA SIS in September and had to use all available manpower on tasks supporting this critical project for much of the past several months, thus delaying the Student Payroll implementation. Also, balancing reports from the new and old systems has been an even greater job than anticipated because of a multitude of program and data inaccuracies in the old system. We did not truly realize how badly we needed this conversion. We have been running parallel systems since mid-October and expect to discontinue the old system in December. Our clients using the new programs in running the parallels are enthusiastic and anxious for the changeover.

Relational/Network Contrasts

The experience on this first DB2 system has taught us a great deal about differences between the network DBMS that we have been using for several years and the new relational DBMS. Much re-thinking of the whole database design and definition process has been required. Major points in our comparison of the two types of DBMSs include:

- In a network system, information about the data is coded into the structure through the sets. Database navigation is more complex because a knowledge of the set names, structures, and order of storage is required. Also, the programmer must be aware of record, set, and realm currencies in all data manipulations. The relational structure is easy to understand - tables as opposed to records and sets. And navigation is strictly by field values. It does, however, require extra columns in the tables to provide the links implied in the network structure.

- A relational system is much more flexible than its network counterpart. New tables are easily added to a relational database as are new fields to existing tables. Indexes can be created and dropped as needed. These updates affect only the application programs that reference the changed or added objects. Usually a restructure is needed to add new fields, records, and sets to a network database.

- As relationships between entities change, these changes are easily defined based on the data in a relational system. In a network database, a restructure is required to define new set structures for these additional relationships.

- In a relational system, a user can be given a logical window into a database through a view and can even become his own DBA and define further views.

- SQL is a high level language used by the DBA, programmer, and user. It includes built-in functions like SUM, ORDER BY, COUNT, and AVG which are not available in the CODASYL DML. The consistency of using the same easy-to-understand language to define and manipulate data is an advantage over network systems.

- We can now, with our relational system, access tables from more than one database in a single application program. This is a limitation of our CODASYL environment that requires us to use calls to other executable modules to access more than one database.
- DB2 security is more extensive than that in our network system. Using SQL commands, privileges can be granted and revoked as required. Through the use of views, this access can reach down to the field level and be based on field content. Also, privilege must be granted to execute database utility and administration functions. Our network system allows the use of subschemas to limit views of the data but subschemas are very cumbersome and do not provide the granularity of security found in DB2.
- The consistency and integrity of data across tables has to be maintained by the application programs in DB2. There is no referential integrity. In a network database, some of this integrity can be handled by the set structure.
- Whether or not an index is used to access data is determined internally by DB2 rather than explicitly stated by the programmer as in a CODASYL environment. This requires that SQL statements be formulated correctly if use of an index is desirable.

Future Administrative Computing Plans

The Administrative Computing Section has a tremendous amount of work ahead that must be done as quickly and efficiently as possible but not without much thought and planning. We have established the policy that all inhouse development will be done in DB2. We have begun design work on conversion of our IDS-II Human Resources system to DB2. Included in this process will be some important enhancements that our clients have requested such as an applicants subsystem. And we are spending time in analyzing how we can make this new system more helpful to the University's executive level. This will be a major thrust of all our future development - to support our decision makers with relevant, timely information in useful formats. Two committees composed of a cross section of members from across campus are winding up studies of potential Financial Information Systems and Alumni/Development Systems. The committees' recommendations and the University's decisions in these two areas will help decide the direction of our work effort in the next two years. A primary consideration in evaluations of vendors' software will be present or future availability of SQL versions. We are facing a very challenging time. A relational database system like DB2 gives us a more flexible, easier to use tool than we have had in the past to aid in accomplishing the tasks before us. As Dr. Reynolds stated in the November 1987 issue of Cause/Effect, "Our plan is to literally try to have the most up-to-date information systems that we possibly can, to lead our people where they have not been before, or where they have not even anticipated going." Administrative computing will be a major factor in this information revolution and in the continued striving to better serve Baylor's students, employees, and friends.

Vendor Participation

Coordinator:
Andy Wehde
University of Iowa

Thirty vendors with computer-related products and services participated in CAUSE87, through vendor presentations and workshops, sponsorship of conference activities, and suite hospitality and exhibits. A list of these vendors appears on the next page, followed by descriptions of some of their conference contributions.

R. Schuyler Lesher
Peat Marwick

Tony Barga
Ernst & Whinney

E. Michael Staman
New Jersey Educational Computing Network, Inc.

PARTICIPATING VENDORS

The following companies participated in and contributed to the success of CAUSE86:

The AIMs Group
American Management Systems, Inc.
Apple Computer, Inc.
AT&T
Business Information Technology, Inc.
Business Systems Resources, Inc.
Campus America
Century Data Systems
Cincom Systems, Inc.
Computer Communications Specialists
Control Data Corporation
Coopers & Lybrand
Datatel Minicomputer Company
Digital Equipment Corporation
EDUTECH International
Ernst & Whinney
Granada Systems Design
IBM Corporation
Information Associates
Integral Systems, Inc.
Lasermax Corporation
New Jersey Educational Computer Network, Inc.
Peat Marwick
Prime Computer, Inc.
Quodata
Relational Technology
Systems & Computer Technology Corporation
Unisys
Wang Laboratories, Inc.

The AIMS Group

The AIMS Group is a user-owned company, a unique relationship which has resulted in the development of a highly-sophisticated, comprehensive, and integrated information system designed exclusively for institutions of higher education.

This group offered demonstrations and materials at their CAUSE87 suite exhibit to show why 30 schools from Maine to Hawaii have chosen AIMS for their administrative software solutions.

American Management Systems, Inc.

American Management Systems, Inc. (AMS) one of the nation's leading computer software and services firms, welcomed CAUSE members and their guests to the AMS CAUSE '87 Suite Exhibit. The AMS College & University Systems Group presented on-line demonstrations of the College and University Financial System (CUFS), and the new PC-based management support products, PCI (the Personal Computer Interface) and Report Painter, our new menu-driven Report Writer Interface. We also presented the new AMS Student Infromation System (SIS), Human Resources System (HRS) and Development Information System (DIS). The Comprehensive Information Resource Services (CIRS) line of technical and specialized information resource consulting, recently introduced by AMS, was discussed with many conference participants.

For more information call Mr. John Reed at 800-336-4786 or write:

Mr. John Reed
American Management Systems, Inc.
1777 North Kent Street
Arlington, VA. 22209

ams

1777 North Kent Street • Arlington, Virginia 22209 • (703) 841-6000 • Telex 64638 • Answerback AMSINC
Regional Offices In: Chicago • Denver • Houston • New York • San Francisco

Apple

Campus Connectivity

Van Jepson
Marketing Manager
Apple Computer

On campuses across the country we have seen a shift from personal computing to inter-personal computing. The minicomputers and large mainframe computers are becoming information providing peripherals. The demand for information is being driven by the administrative and academic computing departments. This is in response to the need for increased administrative productivity as well as improved effectiveness of the research and instructional environments on campus. The phases of faculty research demand computing resources that go beyond the boundaries of most campuses, forcing faculty to reach out to the regional and national networks for collaborative support from their collegues. The role of the personal workstation has new visability during this shift to the information age. Apple will play a major role during this transition with new technologies and in continued support of Higher Education.

Apple's Academic Program focuses on the four aspects of our partnership with Higher Education: Technology Leadership, Innovative Programs, Network of Educators and Academic Tools and Solutions. Our technology leadership spans CPUs, operating systems, networking, communications, printing and imaging. Some of the recent examples are the open architecture Macintosh II, MultiFinder - a first generation multi-tasking operating system and our high quality color display. The goal of our innovative programs is to support the academic mission of the institution while providing the lowest cost, highest quality total solution. This includes the new System Software Update program, site liscensing for HyperCard and A/UX as well as training for campus resellers . Apple supports a stong network of educators. We have an ambitious program that supports higher education developed software solutions, oriented towards research and instruction. The Academic tools and solutions area is focused on the integration of authoring tools for instruction that are discipline specific as well as growing the number of productivity solutions available to students, faculty and administrators

Campus Connectivity (continued)

Apple's networking strategy embraces both the innovation of new technologies and furthur integration into the multi-vendor environments. The foundation of Apples leadership is a full and growing set of innovative technologies, that provide superior functionality for a wide range of applications in networking, printing and in software development . The goal for multi-vendor integration is to have all networked environments able to be seamlessly accessed from Macintoshes. Apple and third party developers have done an excellent job over the last year making the Macintosh connect into the multi-vendor environments. The importance of TCP/IP is recognized and will be available for both the A/UX and Macintosh Operating Systems. A closer link with DEC's minicomputers will provide larger file systems and a more distributed computing environment. The biggest improvement has come with the integration of the Macintosh interface to the IBM communications world.

The Apple Communications Framework (ACF) specifies the architectural under-pinnings that allow the many components of a communications network to work as an integrated system. This framework began with the Macintosh, AppleTalk and Laserwriters. Together these provided Desk Top Publishing solutions. The next three areas extended Apple's network architecture to include standards for file servers and multi-user applications, internetworking and tools that allow MS-DOS PC's to exchange information with the Macintosh family . Apples communications strategy also includes network management and a tighter integration into multi-vendor environments. ACF's architectural guidelines insure that all development, whether internal or 3rd party, is done in a consistent manner.

This is an exciting time to be using the Macintosh in local area networks, as an intelligent workstation, in the mainframe environment and as a window into the world of information.

AT&T
The right choice.

AT&T was pleased to be at Cause '87. Members of our Richmond, Virginia account team, our Education Industry Management staff and numerous AT&T customers enjoyed the Royal Aberdeen suite which featured the theme of "Campus Connectivity". A variety of AT&T workstations linked via a Starlan local area network conducted basic file sharing and electronic mail applications. Many visitors to the suite challenged the power of AT&T's Collegiate Edition of Writer's Workbench to analyze their writing. Those who tried it discovered the distinction between Writer's Workbench and other software programs designed to improve student's writing abilities.

During the workshops, Yale University and New River Community College shared applications from their campuses that incorporated a variety of AT&T data products. The image database created by Yale using the AT&T Targa Board, an image capture technology, "captured" the interest of educators concerned with electronically stored data. New River Community College demonstrated the value to small colleges and universities of making effective use of voice and data products. By designing a combined voice/data network, the features previously thought too costly for small colleges are utilized by New River to bring its students, faculty and administrators into the Information Age.

Besides the Innisbrook surroundings, the AT&T representatives enjoyed and gained insight from conversations with interested and concerned educators. Many of the topics discussed will assist AT&T in responding to the future needs of the education industry. Moving into 1988, AT&T is focusing on improving customer relationships and maintaining a leading edge position among advocates of information movement and management.

We at AT&T look forward to working with you in the future and seeing you again during Cause '88. Any questions you might have regarding AT&T's involvement during Cause '87 can be directed to Jeffrey Miller, National Industry Manager for Higher Education at the address below. See you next year!

AT&T
55 Corporate Drive
Room 14P01
Bridgewater, NJ 08807
(201) 658-6338

JM:bg

Implementing Complex Software Packages

Business Information Technology (BIT), a company that specializes in implementations of complex human resource information systems, provided a dual presentation at CAUSE 87. The presentation covered useful techniques for diagnosing the health of an implementation project and a methodology for assuring successful on-time implementations.

BIT's diagnostic techniques were covered by Paul J. Piper in an overview presentation entitled "Implemania: Frustrations of the 80's." Human Resource System (HRS) implementation projects often encounter road blocks, delays, and a lack of commitment or involvement. As consultants with experience in more than seventy (70) HRS projects, BIT has developed project diagnostic methods that quickly identify the key issues and stumbling blocks through unique, yet extremely practical, approaches.

BIT's methodology for assuring successful implementations was discussed in a presentation by Robert L. Bartman entitled "Incremental Prototyping Techniques to Reduce Software Package Implementation Time." BIT's methodology includes the involvement of the functional user throughout the project. This involvement includes the testing of prototypes to help fine tune the system, as functional requirements of the new system become better understood. It also provides "hands on" training of the primary users to ensure significant user familiarity prior to implementation. The methodology also includes well defined steps and checkpoints to assure that the project remains on schedule.

BIT has been specializing in implementations of payroll/personnel software packages for mainframe computers for over six years. Their clients include many colleges and universities.

Business Information Technology, Inc.
1011 Centre Road, Suite 400
Wilmington, Delaware 19805
302-996-0720
800-448-4300

BSR

Business Systems Resources, Inc.

BSR's suite exhibit at CAUSE87 featured Advance, the most comprehensive system available for institutional advancement, designed to support the needs of the largest and most demanding development organizations.

On-line features include maintenance and inquiry of extensive biographical data and relationships, entry of pledges and gifts, full giving history, and support of major prospect tracking and campaign management functions. Interfaces with accounting systems and word processing are supported. Exceptionally easy to use, Advance features a menu structure for selecting functions, a powerful name-lookup function for persons and corporations, and powerful query facilities for ad hoc reporting. Advance versions are available for both IBM and Digital VAX computers.

DAReL, DEGREE AUDIT REQUIREMENTS LANGUAGE

Presented by

Ben Bassett

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Student advising and the tracking of progress towards a degree are two tasks which virtually every college and university would like to automate. Based on the requests and input from the 280+ strong **POISE** Users Group, Campus America has developed a new "Degree Audit/Academic Advisement" system.

The Degree Audit/Academic Advisement System (DA/AA), using a "computerized" school catalog, evaluates a student's schedule and transcript to produce a "Degree Audit Transcript." The Degree Audit function evaluates the progress towards a degree choice (including majors and minors.) The Academic Advisement function allows for interactive "degree shopping," and is an exceptional tool which advisors can use, with the student present, to prepare for future semesters.

DA/AA uses data from several different sources to evaluate a student's progress towards a degree. The current term schedule, as well as historical information would be the primary information. In addition, an "exceptions" file is available to store and evaluate other important items such as "life experience," CLEP, and waiver information.

The college/university catalog (allowing for different catalog years) is defined using DAReL, the Degree Audit Requirements Language. DAReL is a non-procedural English-like language based on "Expert Systems" technology.

DAReL - continued

The primary output of the Degree Audit/Academic Advisement system is the degree audit transcript. This report is similar to an academic transcript. It lists each requirement, indicates the student's progress towards that requirement, and the course or waiver, if any, that applies to the requirement. Unfulfilled requirements are listed as incomplete, current semester/term requirements are listed as in progress, and those requirements which have already been fulfilled are listed as complete.

The Degree Audit/Academic Advisement System is a separate POISE VAX-based module. DA/AA is integrated with the POISE Registration/Academic History module and also requires DMS-Plus (the POISE Relational Database Management System/Fourth Generation Language.) All POISE software is available for the Digital VAX (including MicroVAX processors) computer system.

HIGHLIGHTS:

- Automatic curriculum evaluation for any number of students
- Interactive academic advisement (Degree Shopping)
- Easy accommodation for individual student programs
- Catalogs defined in an "English-like" non-procedural language
- Mutiple catalogs (for different school years)
- Provisions for CLEP, transfer, waiver, and general exceptions
- Functions on any Digital Equipment Corporation VAX/MicroVAX computer using the VMS operating system

* VAX, MicroVAX, and VMS are trademarks of Digital Equipment Corporation

CINCOM

Cincom Systems was a regular participant in the CAUSE National Conference in the 1970s and, since joining CAUSE in 1984, has continued to participate through vendor presentations.

STRATEGIC SYSTEMS ARCHITECTURE

The information processing requirements of the modern educational institution will change drastically over the next ten years. We will see an emerging focus on strategic (ie, mission-critical) systems. These new types of systems must be based upon a different foundation from the tactical "back office" applications of the past. This paper focuses upon the four major "building blocks" that form the foundation for these strategic systems:

- The Relational Model
- Three-Schema Architectures
- Enterprise Modeling
- Dynamic Dictionary/Directories

This paper is a foundation for a presentation which also included a case study. This case study delineated and substantiated cost savings when applications are implemented on the above modern foundation.

THE RELATIONAL MODEL

We will assume that most readers are familiar with the external basics of the relational model, i.e. relational tables and relational operators. But the relational model also contains another important facet, data integrity constraints. Entity and referential integrity are overlooked or trivialized by most DBMS vendors. These integrity constraints are more than just "relational theory." They depict real situations that are rooted in the fundamental principles of how the organization conducts business. One example of a business rule (or integrity constraint) might be "we cannot register a student for whom we have no transcript." Unfortunately, these constraints must be manually enforced by the programming staff if they are not enforced by the DBMS. If the DBMS does not enforce these integrity constraints, then the DBMS does no more for the organization than VSAM does today.

THREE-SCHEMA ARCHITECTURE

Most MIS organizations spend 50 to 80 percent of their programming resource on maintenance. This essentially means that the programming staff spends from 8:00 a.m. to somewhere between noon and 2:00 p.m. keeping existing systems operating before doing anything that relates to the new information needs of the organization.

A DBMS which is implemented via a three-schema architecture can offer significant relief from the maintenance headache by providing complete logical and physical data independence.

Another benefit of a true three-schema architecture is its ability to completely support DBMS products from multiple vendors "under the covers." Most organizations store their data resource using a variety of products (VSAM, DL/1, sequential files, etc.). A relational DBMS which is implemented via a three-schema architecture will provide a "global" picture of the data resource to both MIS and the user community.

THE ENTERPRISE MODEL

Within the framework of the three-schema architecture, applications "talk" to "external" schemas which are mapped onto a "conceptual" schema, which is then mapped onto an "internal" schema. The conceptual schema is the data model of the organization. It is a logical representation of data according to how the enterprise conducts business. It is the enterprise model.

This enterprise model contains the business rules of the enterprise ("a student can not drop a class for which he or she isn't registered"). In a three-schema architecture, these business rules are then enforced by the DBMS. Most current relational DBMS products do not fully support the concept of an automated enterprise model. With these products, business rules must be enforced by the programming staff.

THE DYNAMIC DIRECTORY

The three previous concepts can prove useful only if they can enforce order while programs are executing. This requires a dictionary which is active at execution time (dynamic) rather than at compile time (active). A dynamic directory is the true "control center" for application execution.

SUMMARY

The synergy of the four foundation components of the strategic systems architecture can provide many benefits to an organization. A relational DBMS, implemented via a three-schema architecture (which supports the enterprise model), controlled and managed by a dynamic dictionary can provide significant productivity increases to MIS. These productivity gains will result in a decrease in application development and maintenance cost.

However, the "real" benefit to the enterprise lies outside the realm of MIS. Applications built upon the above foundation will ensure that management has accurate data (and thereby accurate information) upon which to base its decisions. Application systems built upon such a foundation will ensure accurate and consistent management information.

INVOLVEMENT IN HIGHER EDUCATION

CINCOM and SCT

Cincom and Systems and Computer Technology Corporation (SCT) have had a joint higher education relationship since 1980. Today SCT bases the Symmetry Series, an integrated IBM mainframe group of software packages for the higher education market, around SUPRA, Cincom's advanced relational DBMS.

SCT's integrated packaged software for higher education applications includes the Integrated Financial Information System (IFIS), Integrated Student Information System (ISIS), Alumni Development and Donor System (ADD), and Human Resources Information System (HRIS). This program will allow SCT's clients to take advantage of the fourth-generation development tool kit available under Cincom's SUPRA.

SUPRA provides a tool kit to end users which includes: SPECTRA, an easy-to-use relational query facility; MANTEXT,a powerful free-form text processing system that lets users develop sophisticated applications that integrate both text and data; MANTIS, a proven fourth-generation application development system which offers prototyping capabilities and a full-function development language that provides efficient production performance; and PCCONTACT, communications software that integrates personal computers and mainframes.

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COMPUTER COMMUNICATIONS SPECIALISTS, INC.

Atlanta / Peachtree Corners Business Park
6683 Jimmy Carter Boulevard / Norcross, Georgia 30071
Telephone 404 441-3114 / Telex 80-4294 SPEDEX, ATL.

Computer Communications Specialists, Inc. (CCS) is pleased to announce its Corporate Membership in CAUSE.

As an exhibitor and CAUSE Corporate Member, CCS held a "Hands-On" Workshop December 1, to introduce its Dean's Assistant Telephone Registration system. The Workshop gave Registrars and Administrators the opportunity to become acquainted with the basic operation of the system and to experiment with the ScriptWrite Application Development feature.

With the Dean's Assistant Telephone Registration system, students can register from the convenience of any Touch Tone telephone. For the student this means no more long registration lines and no more frustration. For the College, the Dean's Assistant eliminates the need for additional staff and training to handle peak registration periods. With ScriptWrite and simple recording/editing features, the Dean's Assistant can be designed to meet your individual requirements on site by your staff.

In addition to Telephone Registration, the Dean's Assistant can also provide telephone access to Admissions and Housing information as well as processing of transcript requests and reporting session grades.

Waubonsee Community College, a CCS Customer, also gave a presentation entitled "How to provide Telephone Registration without Breaking Your Budget". CCS assisted Waubonsee during the presentation by providing additional technical information during the Question & Answer session.

For more information about the CCS Dean's Assistant Telephone Registration system, Contact : Lovette Twyman at (404) 441-3114.

CONTROL DATA

Single Supplier for Administrative and Academic Computing Solutions

Control Data Corporation has been committed to the support of college and university data processing for more than 25 years. To meet the needs of academic institutions, Control Data provides both software and hardware solutions for the full range of educational computing requirements.

Software Solutions

A few examples of the software products offered by Control Data Corporation include computer based education - PLATO, an office automation system - Officeware, an administrative suite of applications - Eden, and a powerful, fully relational data base management system, IM/DM. The combination of these products enables colleges and universities to effectively utilize computers within all segments of the academic arena.

Computer Products

Control Data's CYBER 180 series systems were designed with the needs of higher education sharply in focus. CYBER systems are used by students and faculty world-wide -- from small liberal arts colleges to multicampus universities -- performing research in such areas as CAD/CAM, geophysics, electrical engineering, and image processing; performing administrative and data management functions; delivering computer-based instruction; and delivering computer-based instruction to students in a variety of academic disciplines. From the air-cooled, departmental-level CYBER 930 to the top-of-the-line, near-supercomputer Models 990E and 995E, users can achieve more than a fifty-fold increase in computing performance with the same operating system, thereby protecting the investment in both the equipment and the application software packages which are designed to operate on it.

For additional information, please contact :

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C&L

Coopers & Lybrand

Using Structured Analysis Tools for Package Implementation

Glenn Rosenberg, Manager
Robin Scott, Manager
Vasco Leitao, Partner
Management Consulting Services
Coopers & Lybrand

In this presentation, C&L management consultants described current experiences using structured techniques to implement administrative software packages for two major university clients: Michigan State University's Student Information System, and Virginia Tech's Financial Systems.

Structured techniques apply to all aspects of planning, analysis, design, and programming. These techniques include:

- consistent presentation formats
- understandable graphics
- data modeling
- data flow diagrams
- complete and clear process descriptions
- self-documenting procedures

The speakers also discussed the integration of Coopers & Lybrand's automated Computer-Aided Software Engineering Tool Kit to produce systems models which are understandable to all levels of management, and which can be modified instantaneously.

DATATEL

Datatel showcased its two major products, Colleague• and Benefactor•, at the 1987 CAUSE conference. Both are computer based systems that automate many of the time consuming tasks that can hamstring the effective administration of colleges and universities.

Colleague, a multi-faceted system that extends the processing of information to virtually every department of an institution, has been carefully crafted to meet the needs of today's administrator. It is a mature product that enjoys the benefit of nine years of evolutionary improvements resulting from Datatel's experience in the higher education marketplace.

Benefactor is a new Datatel product that supports alumni development activities. This system is comprehensive in scope and features advanced display techniques and computer directed access to critical alumni and activity data.

Both Colleague and Benefactor feature a relational type data base and a user oriented query language. These features give the end user the ability to access every element in a database. To those accustomed to more traditional data processing systems where programs or reports have to be generated by the "DP" department, this offers a new element of freedom and control. It gives decision makers the ability to access the information they want, when they want it.

Datatel demonstrated its latest release of Colleague at the CAUSE conference. This version featured new capabilities in financial aid and on-line billing. Colleague has 21 separate software modules that automate recruiting, admissions, registrar, records, grades, transcripts, financial aid, accounts receivable, accounts payable, inventory, fixed assets, payroll, and personnel, to name just a few. The Colleague system has been installed at over a hundred institutions in the United States.

Colleague users delivered technical papers at the conference that featured the capabilities of the Colleague support team which produces new releases and provides implementation, training, and technical support.

Benefactor, Datatel's fund-raising system for higher education, was well received by conference attendees. Benefactor contains modules for individual donor information, organization information, gift and pledge processing, correspondence management, major donor tracking, planned giving, activities and events, campaign management, proposal management, and membership processing. Benefactor's advanced display and screen handling techniques drew a lot of attention at the conference. These include extensive use of function keys, nested multi-level windows, direct access functions for pertinent data, comprehensive "help" functions, and computer decision making based on user specified parameters. If you'd like to know more, about our company or our products, please call Bill Petersen at 703-968-9000.

Datatel, which is celebrating its 20th year of business, is looking forward to another active year in the higher education field and in its valuable association with CAUSE.

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digital

DIGITAL EQUIPMENT CORPORATION

Digital participation in CAUSE 87 centered around two activities: sponsorship of the registration reception and a hospitality suite. The registration reception included video highlights of DECWORLD and featured some of the CAUSE members who attended that event. In the Digital hospitality suite a wide array of administrative and academic solutions were available for demonstration. Highlighted among these were a system network connecting the Digital suite to Apple and other vendors,BITNET connectivity, and VAX Integrated Publishing, a Digital electronic publishing system.

To the many CAUSE 87 attendees who visited the Digital suite, we thank you for your time and interest. We look forward to seeing you again at CAUSE 88.

INTELENET

INDIANA'S EDUCATION AND GOVERNMENT NETWORK FOR THE FUTURE

BOB HACKING, PARTNER
TONY BARGA, SENIOR MANAGER
ROD TRUE, MANAGER

ERNST & WHINNEY
CHICAGO, ILLINOIS

ERNST & WHINNEY PRESENTED "INTELENET," A JOINT EFFORT BETWEEN STATE GOVERNMENT AND HIGHER EDUCATION TO DEVELOP AND IMPLEMENT A STATE-OF-THE-ART TELECOMMUNICATIONS NETWORK FOR THE STATE OF INDIANA. NEW COMMUNICATIONS CAPABILITIES TIE TOGETHER 34 INDIANA CITIES WITH AN END-TO-END FIBER OPTIC BACKBONE NETWORK CARRYING VOICE, DATA, AND VIDEO TRAFFIC FOR PUBLIC SECTOR ENTITIES, AND PUBLIC AND PRIVATE EDUCATIONAL INSTITUTIONS. BENEFITS INCLUDE A SUBSTANTIAL REDUCTION IN COMMUNICATIONS COST FOR LEASED-LINE FACILITIES, A REDUCTION IN NETWORK REDUNDANCY IN CURRENT DATA NETWORKS, A GREAT INCREASE IN AVAILABLE CAPACITY OVER THE CURRENT HIGHER EDUCATION MICROWAVE NETWORK, AND AN OPPORTUNITY TO INTEGRATE AND CONSOLIDATE NETWORK MANAGEMENT. CLASSES AT PUBLIC UNIVERSITIES CAN NOW BE BROADCAST TO LOCAL HIGH SCHOOLS AROUND THE STATE, AND INDIVIDUAL CITIZENS CAN REQUEST AND RECEIVE INFORMATION CONCERNING UNIVERSITY CLASSES FROM LOCAL LIBRARIES.

Ernst & Whinney
Quality in everything we do.

Ernst & Whinney

150 South Wacker Drive
Chicago, Illinois 60606
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INTELENET

The Subject...

Ernst & Whinney presented how INTELENET, a state-of-the-art telecommunications network, will tremendously improve voice and data communications for both higher education and the State government in Indiana.

The Opportunity...

Indiana universities needed to increase their capacity to provide video education capabilities. Indiana government needed to reduce their costs for communications.

The Idea...

The idea was to pull together major public sector users of telecommunications to leverage the aggregate demand required for the future, and integrate networks rather than separately create them.

The Benefits...

The beneficial results of this project will be a reduction in data network redundancy, a substantial reduction in communications cost for leased line facilities, a great increase in available capacity, and an opportunity to integrate network management.

The Evidence...

Evidence of this idea's potential success was supported by experiences in video education with data networks in the private sector. Multiple studies were conducted and indicated the benefits could be achieved. Included in the studies were evidence that costs of individual networks were rising dramatically.

The Conclusion...

INTELENET resulted in the acquisition of significant new communications capabilities which will eventually tie together 34 Indiana cities with an end-to-end fiber optic backbone network carrying voice, data, and video traffic for public sector entities, and public and private educational institutions.

As the audience listened to our presentation, everyone gained insight into how a high level study group of university presidents and key State government officials were brought together to effectively open up the management of Indiana's State telecommunication networks.

The Next Step...

Ernst & Whinney provides a full complement of Information Systems Implementation Services, from initial project definition and requirements review to final implementation activities. E&W can help guide you through the entire project lifecycle process. You benefit from our broad range of services and expertise to effectively implement your project needs. Please refer to the E&W Corporate Member Profile for more detail about our services.

For more information, please contact Rod True or Chuck Raz at 312/368-1800.

GSD

Granada Systems Design

Granada Systems Design, a value-added reseller of the Conversant 1 voice system, and At&T Conversant Systems jointly hosted a suite to demonstrate how colleges and universities can benefit from the use of the Conversant 1 voice system.

This system is a voice-response computer system allowing callers to retrieve host information via the telephone. The Conversant 1 system provides a cost-effective way to offer course registration, add/drop courses, or provide information about financial status, student activities, course information, and admissions. The exhibit introduced Granada's new applications generator, and allowed conference-goers to test software by registering for courses themselves.

The IBM Corporation

In addition to sponsoring the Thursday luncheon at CAUSE87, IBM offered a suite exhibit featuring the company's new PERSONAL SYSTEM/2 family of products, a desktop publishing system, and a display of application briefs from several institutions.

Information Associates®

IA Introduces New Services Division

Cade Adams, principal, and David Sheive, vice president, unveiled a new IA offering. Information Associates' new Management Services Division provides a full range of assistance for customers: computer resource and project management, telecommunications support, customized system design, training, documentation, and ongoing product updates.

MSD starts with planning for the user. IA gets things underway with strategic planning: What does the user want to do? Operational planning follows. Information Associates works with the user to develop feasibility studies, cost estimates, personnel requirements, and data base design.

Next, implementation planning gives IA and the user a chance to review personnel and equipment strengths and correct weaknesses.

Implementation and production support complete the MSD package. IA prepares an implementation plan and monitors it to assure timing and cost containment. Maintenance and development plans are designed to keep the system operating optimally and to direct modifications that meet changing demands.

Live Demos Tout IA Systems

Relational Data Base Technology Steals Show

The first-ever demonstration of IA's relational data base technology headlined Information Associates' three days of on-line exhibits. The new technology uses VAX Rdb/VMS™, ORACLE™, and FOCUS™.

Ongoing demonstrations of IA's Loans Management, Financial Records, Alumni/Development, Human Resources, and Student Information systems gave CAUSE87 participants a chance to see the company's evolving systems in action.

IA Workshop Targets Fault Avoidance

Bryant Stringham, vice president of marketing with Sage Analytics, Intl., and president of Sage Canada, discussed breakthrough technology at the IA workshop -- "Improving Project Management Through Fault Avoidance Methodologies." These methodologies are incorporated in IA's contract with IBM and California Polytechnic State University.

Designed to help computer centers improve service to users, fault avoidance methodologies are currently part of the system that will run the 1988 Winter Olympics in Calgary.

Digital and IA Join Resources for Relational Technology

IA announced its agreement with Digital to jointly develop and market a new software product for higher education administration. IA will integrate Digital's ALL-IN-1™ office automation software and VAX Rdb/VMS™ relational data base management software in a new version of Series Z™. This new product will give users the flexibility of relational data base technology in administrative computing on mainframe computers. It will run on the full range of Digital VAX™ computer systems.

IA/IBM/Cal Poly Alliance Announced

IA's contract with IBM and California Polytechnic State University for administrative computing capabilities was explained in an IA vendor session by James L. Strom and Arthur S. Gloster, vice presidents from the university.

The Cal Poly connection is part of a joint study agreement developed between IA and IBM to assist three universities unable to acquire funding from the State of California for computing needs. Under terms of the agreement, IA will design information management software to support IBM's relational data base technology, DB2™, for an intercampus information system. This cooperative research venture is perhaps the largest of its type in a university setting.

Campanella and Penrod Win CAUSE Excellence Awards

CAUSE annual Recognition Awards for excellence and leadership in information management technology were presented to Dr. Frank B. Campanella, executive vice president of Boston College, and James I. Penrod, vice president of information resource management, California State University at Los Angeles. These annual awards are sponsored by Information Associates.

IA Suite Reception Has Participants Feeling in the Pink

Pink punch, pink flowers, pink ties, pink flamingos set the scene for IA's annual suite reception. Guests left with top hats and an appreciation for IA's renewed commitment to quality products and customer service.

80 Golfers Vie for Titles

CAUSE golfers had a chance to test their skills on Florida's #1 course at IA's annual tournament. Information Associates welcomed a field of 80 golfers to the Copperhead Championship Golf Course on Tuesday morning. Trophies were awarded for low men's and low women's scores and closest to the pin.

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WITH THE
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INTEGRAL SYSTEMS

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CAUSE 87

We certainly hope that CAUSE 87 was as interesting and productive for you as it was for us. On Tuesday and Wednesday nights we hosted a vendor suite exhibit; hopefully you were able to stop by. In addition to enjoying the wonderful food and beverage, attendees learned more about Integral Systems' Human Resource Management System.

We also had the opportunity to discuss future product plans and enhancements with many of our existing clients who visited us. CAUSE 87 was a resounding success and we look forward to seeing you in 1988.

COMPANY PROFILE

Integral Systems has been dedicated exclusively to human resources management since 1972. With close to 300 employees working out of eight offices across the nation, the firm offers a full range of high quality training, consulting, and maintenance programs. One third of the organization is dedicated solely to client support.

Integral Systems spends nearly twice the industry norm on research and development, thus assuring that its software is technically innovative and based on the very latest native data base technology (including DB2).

INVOLVEMENT IN HIGHER EDUCATION

Integral Systems has long recognized the special needs of the academic community and has designed its software for the higher education marketplace.

PRODUCTS AND SERVICES

Integral Systems' products cover the entire spectrum of Human Resource Management. Products include: Personnel Management, Payroll Processing and Reporting, Benefits Administration, Pension Administration, Position Control, Applicant Tracking, analytical Human Resource tools for microcomputers, advanced data security, report generators, and native on-line products written in IDMS ADS/OnLine, NATURAL, IDEAL, as well as the industry's first native DB2 solution. These technologies provide for unusually fast implementations and integration into advanced data processing environments.

Integral Systems products are designed to include a lengthy list of built-in features that are of significant value to the higher education community. The Human Resource Management System is in operation at numerous two-year colleges, local community colleges, four-year colleges and universities, and land grant institutions throughout the United States and Canada. These colleges range in size from 1,000 to 80,000 employees and include the following clients:

- Boston College
- Harvard
- Rutgers
- Columbia
- Catonsville Community College
- York University (Canada)

Higher-education-related features in the Human Resource System include such capabilities as:

- Multiple concurrent appointments
- "Without salary" appointments
- Management of curriculum vitae information
- Department action notices
- Special forms of payment, e.g., stipends
- Payment start and stop dates
- Multiple payment frequencies
- Payroll expense distribution
- Benefits administration
- Identification of special relationships
- Contract and grant certification
- Faculty and staff employment history
- Position control
- Faculty and staff salary analysis
- Tenure tracking

RECENT ACTIVITY

Integral Systems is pleased to announce that it has been selected by IBM as a designated Application Enabling IMAP for DB2, SQL/DS, and CSP.

Under the IMAP relationship, Integral Systems may market its family of application software products with IBM branch office personnel to IBM customers and prospects. Integral Systems, Inc., a CAUSE member since 1979, has participated annually at the CAUSE National Conference since 1974 through vendor presentations and the sponsorship of refreshment breaks. It has hosted a conference suite exhibit annually since 1983.

CONTACT

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LASERMAX CORPORATION

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(303) 526-1229

LaserMax showed at its CAUSE suite a prototype of an Optical Memory Card system. This credit-card size storage device, which holds up to 2,000,000 bytes of textual or graphic information, is the basis of the LaserMax Campus System. This system is being developed by LaserMax in conjunction with several universities.

Functions of the LaserMax Campus System include the following:

- Identification and security: the card can store student demographic information, as well as optional graphics such as photographs or signatures. The card can be used as positive identification and for access control.

- Registration and fee status: by storing such information as current term registration information and the fees paid (date, type, amount), the card can be used an authorization mechanism for libraries and other campus facilities.

- Cash card: the school can use the Optical Memory Card system as a substitute for or adjunct to the use of cash at campus locations. The "write-once" storage medium provides an ideal mechanism for use as a cash card with audit trail.

- Transcript storage: storing transcript information on the student's card allows for easy interaction with LaserMax- or school-provided academic requirements and curriculum systems. By using off-line microcomputers, the student can analyze his own academic program against degree requirements, prerequisites and class schedules. Advisors can then spend more time on advising, less on developing course schedules.

- Health services card: stores emergency medical data for use in campus clinics or off-campus facilities. More complete medical records can be stored on the student's card if there is a need to visit a variety of medical facilities.

Because the Optical Memory Card uses laser optical storage, the medium is a "write-once" technology. It is not subject to magnetic erasure, and is substantially more durable than magnetic stripe data storage. (A magnetic stripe, OCR or bar code strip, and/or photograph can be affixed to the reverse of the card for compatibility with existing systems.) The card is less expensive than an integrated-circuit "smart" card and holds up to 100 times as much information.

LASERMAX CAMPUS SYSTEM

The LaserMax Campus System can improve efficiency, reduce costs, and offer substantial performance improvements in administrative, security, and medical services.

Applications include:

- Student/Faculty/Staff ID
- Registration Data
- Fee Payment Status
- Access Control
- Curriculum Information
- Medical Data
- Library Card
- Cash Card
- Transcript Storage

All information can be carried by the student on a single plastic "Optical Memory Card":

DREXON
LaserCard

Actual Size

The LaserMax Campus System is based on the Drexler LaserCard®, capable of storing up to two megabytes of digital data. This is enough memory to hold up to 800 typewritten pages, and/or a number of graphic images (photographs, signatures, medical X-rays, etc.) The LaserCard "write-once" medium is not subject to magnetic erasure, and is substantially more durable than normal (magnetic stripe) credit card data storage. It holds up to 100 times more data than an integrated-circuit "smart" card.

LaserCard® is a registered trademark of Drexler Technology Corporation.

New Jersey Educational Computing Network, Inc.

NJECN and M&H Group—A Relationship that Works!

E. Michael Staman
Director, Sales, Marketing, & Client Services
New Jersey Educational Computing Network, Inc.

Donald M. Norris
Vice President
M & H Group, Inc.

Two firms, the M & H Group, Inc. and NJECN, Inc., recently joined forces to provide a unique, extremely affordable, and much-needed array of services to the higher education community. The target market for these services includes all of higher education, but particularly those institutions with a need to assess or expand their technological resources or services which are operating on limited budgets. Important aspects of the relationship are "honest brokering," strategic planning, and technology counseling similar to EDUCOM or ACM peer review groups, and delivery of either technological resources or personnel services and consulting through the unique, not-for-profit status of NJECN, Inc.

This presentation at CAUSE87 included both revenue-generation ideas and techniques to provide computing services in a cost-effective manner.

KPMG Peat Marwick

Managing Information Technology

by Douglas W. Brockway, Nolan, Norton & Company; and
R. Schuyler Lesher, Jr., Peat Marwick

A recent survey conducted by Peat Marwick, EDUCOM, and The Chronicle of Higher Education *entitled* Microcomputer Use in Higher Education *confirmed the strategic nature of information technology today. The results showed a high correlation between technology—defined as microcomputer availability, access, and support—and an institution's degree of competitiveness.*

The information technology revolution is rapidly forcing colleges and universities to change the way they do business. Computers no longer just support academic data processing programs and administrative functions in the controller's, registrar's, and development offices. Information technology is now a strategic part of the management process. How well an institution copes with technological change may determine its ability to compete successfully for students who are demanding technology to support the educational process.

A recent survey conducted by Peat Marwick, EDUCOM, and *The Chronicle of Higher Education* entitled *Microcomputer Use in Higher Education* confirmed the strategic nature of information technology today. The results showed a high correlation between technology—defined as microcomputer availability, access, and support—and an institution's degree of competitiveness. The more competitive institutions appear to have recognized the importance of technology to maintaining their selectivity in attracting students. However, to remain competitive at any level now means being able to manage the technological advances of today and tomorrow. To do this, institutions will need to reexamine the way information systems (I/S) have been managed in the past and to find new ways to harness information technology in today's higher education environment.

. . . the group developed the following working definition of an information utility: "A provider of common information processing, storage, retrieval, and transport services to a standardized customer interface point at an agreed to and understood quality, service level, and cost."

One way of reexamining the management of information technology is to look at it as a utility. Using such an approach means viewing information technology from a strategic perspective, focusing on the best method to meet an institution's needs as a service utility might support the community at large. In 1985, Nolan, Norton & Company, an information technology firm of Peat Marwick, convened a working group to address the notion of "information utility." The group focused on developing a useful and meaningful method of defining an information utility for information technology (I/T) management purposes and to differentiate it from the other approaches to I/T management.

In addressing this concept, the group developed the following working definition of an information utility: *A provider of common information processing, storage, retrieval, and transport services to a standardized customer interface point at an agreed to and understood quality, service level, and cost.*

This approach focuses on the major elements of a utility, which are to:

- Provide commonly used services, generally not those used only by a few targeted groups;
- Provide services that run the gamut of I/T services and would not be restricted in any way to data processing;
- Provide interfaces that are defined and standardized; and
- Provide quality, service level, and costs agreed to and understood between the utility and the community that it services.

This definition implies no physical centralization. In fact it is specifically designed to apply to distributed resources as well as central resources. However, it does imply a consolidation of responsibility and control over the technology and the service it provides, the supporting I/T resources, and the funds to acquire those resources.

In considering the information utility concept, it is important to recognize that not all services would be managed in the manner of a utility. The utility is simply a method of managing those services that are common to the community and on which the community depends. Further, the utility does not have to be an organization or structure per se. It might evolve from a series of utility-like services that are consolidated in their management over time. However, the goal of utility services would be to provide a foundation and the building blocks for downstream automation, dollar savings through better use of technology, and the extension of capabilities in nonutility services.

In setting forth a strategy for developing a utility, an organization needs guidelines and targets to stay on course. The following ten principles were developed by the working group:

1. The economic activity of the utility is *delivery*. A utility provides the users with services and facilities they need but cannot afford to develop themselves.
2. The utility is tightly linked with the information systems *architecture*. The utility implies an engineering response to a global need—a structured set of technologies implemented for general use.
3. Utilities are fundamental *infrastructure*. That is, a utility is the installation and operation of resources (personnel, technology, and facilities) best defined as infrastructure.
4. Formalization of the *external interfaces* is a key part of the process. This means defining external interfaces in such a fashion so that they are consistently applied and broad in their use.
5. The utility is established as a regulated *franchise*. The dependency issue in infrastructure implies that the service must be available. To assure that it is, a regulated franchise is needed to protect the service.
6. *Service levels and standards* are part of the franchise. This means that service levels and standards of use must be generally applicable to all users.
7. Maintaining acceptable service levels is contingent upon *capacity management*. Service levels cannot be maintained if sufficient resources are not available to meet demand.
8. *Internal interfaces* for intra-utility management are common practice. Utilities are meant to be effective for a wide-ranging set of uses, usually with a complex set of technologies, while maintaining a high degree of internal efficiency. This requires structuring the internal prices of the utility for connectivity, flexibility, and flow of services and/or information.
9. The utility is managed under a *split management* concept. A utility must manage things in a "steady state" as well as under"development/planning" and distinguish between things that are "internal" to a utility (and under the I/T management) and those things "external," which are the users' responsibility.
10. The utility is considered to be a process. As a process, it involves more than the development of new services, technologies protocols, and procedures. It assumes that an organization can bring changes into the "steady state" using *architecture* as a base, *external interfaces* as a buffer for change, *internal interfaces* for modular change, and management framework with channels from development to production built into the process.

In planning for a utility, one should consider all the principles and should plan to establish an environment in which most, if not all, of the principles are in place. Establishing these principles may require significant changes in the people and organizations supporting information technology advancement. Such changes can be traumatic for an organization and must be approached carefully. The utility planner must evaluate the organization's acceptance of tolerance for these process assumptions and determine how best to change attitudes, inside and outside of I/S that are resistant to it. This will be one of the significant challenges of developing an information utility.

However, in the rapidly changing world of information technology, institutions will have to reexamine their approaches to I/T management. In addressing I/T management, the information utility option is worth investigating.

Prime Computer, Inc.

Prime Computer, Inc. develops, manufactures, and markets superminicomputer hardware and software, offering administrative, academic, and CAD/CAM solutions to the education marketplace. Education industry specialists from Prime demonstrated the company's latest entry into the Unix environment as well as a full line of fourth-generation products at Prime's CAUSE87 suite exhibit.

Prime also conducted a workshop on fourth-generation languages during the conference, offering participants hands-on exposure to 4GL relational-based data-management products, to let them discover how easily they could organize, create, modify, and manipulate data and develop applications for end users.

A RELATIONAL SOFTWARE ARCHITECTURE
DESIGNED FOR CHANGE

Myron E. Congdon, Quodata Corporation

Abstract

A major challenge for computing managers in higher education today is balancing three competing requirements: (1) satisfying increased demand, (2) minimizing costs and (3) maintaining control while sharing responsibility. The advent of relational database management systems (RDBMS) promises partial relief, but only a new application software architecture based on extensive user-defined parameters will bring substantial benefits.

Such a software architecture provides more than the standard application products with most features demanded by sophisticated users. It addresses three levels of potential users. The RDBMS is thoroughly integrated within the application design. This new architecture gives users control over an extensive array of parameters, and will allow software updates which retain all modifications made by the user. It also functions in a networked environment.

I. The Challenge

  A. Satisfying increased demand, usually with more extensive customization

  B. Minimizing costs

  C. Maintaining control while sharing responsibility with an increasingly diverse group of users

II. Demand is coming from three user levels with different needs.

  A. Senior Administrators want bottom-line information, specific individual data, limited decision support, all with one-keystroke simplicity.

  B. Office Management personnel need increased functionality, tighter procedures and security, more flexible query and reporting, and implementation assistance.

  C. Computing Services must have flexibility with networking, software architecture, quality tools, implementation assistance, and control of campus-wide design and security.

III. Cost minimization must include both initial purchase of communications, hardware, and software, and the on-going software maintenance and personnel training and support expenses.

IV. Control must be maintained while sharing responsibility with the users.

  A. The personal computer is changing demand patterns.

  B. User departments experience problems with too few skills and insufficient personnel.

  C. There is increased demand for interdepartmental information.

V. Some Possible Partial Solutions

  A. The Relational DBMS is helpful, but does not directly address the needs of Senior Administrators and/or Office Management people.

  B. Fourth Generation Languages (4GLs) are promising, but still place the burden on Computing Services and use computing resources inefficiently.

  C. More sophisticated applications that are designed to be changed are necessary because users cannot give up any existing functionality.

  D. A single vendor cannot address all the problems; Computing Services must also be involved.

VI. The Quodata Approach

  A. A standard system includes a tailorable library for changes without programming, and allows easy updating of the software while keeping previous modifications.

  B. Control is maintained by Computing Services with greatly expanded flexibility for creating and changing screens, sort/selection criteria, query, reports, letters, menus, and other processing and and import/export functions.

  C. Service and support are very important components in the decision.

VII. Meeting the Challenge -- Two Different Paths

  A. Creating in-house applications, even with a RDBMS and/or 4GL is a very expensive solution when the long term modification and personnel costs are considered.

  B. Buying new generation application products based on a RDBMS with a flexible architecture designed for change can not only save money, but significantly reduce the time to become operational and meet the users' needs.

INGRES

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During CAUSE87 Relational Technology announced to CAUSE members the most dramatic discount program in our history. The program, EDUCATIONAL SITE LICENSING is designed to let you take full advantage of INGRES for administrative, research and teaching use throughout your institution. We believe this exciting program will encourage the adoption of INGRES as the "standard" distributed SQL relational database on your campus(es) ... and eventually on every major campus in North America!

Hundreds of major colleges and universities around the country have chosen INGRES, the Distributed SQL Relational Database System for ADMINISTRATIVE, applications. In fact, such prestigious institutions as Carnegie-Mellon University, MIT, the University of Colorado, NYU Graduate School of Business and the University of California rely on INGRES for their data management needs.

Relational Technology's primary product is INGRES, the Distributed SQL Relational Database System. INGRES combines an open-architecture distributed database capability with integrated fourth generation application tools and a high-performance SQL database. Relational Technology's INGRES is available for many operating environments including IBM mainframes, DEC VAXs, IBM compatible PC's, and more than two dozen UNIX operating system based computers.

INGRES is by far the largest selling relational database product in the Educational market. A sampling of customer-built administrative applications discussed at CAUSE87 follows:

Admissions
Fundraising
Financial Aid
Registraton
A/P, A/R, G/L
Student Loan Registration
Human Resources
Physical Plant
Space Planning
Parking Permits
Academic Advising
Public Relations
Contracts/Purchasing
Library Serials/Acquisitions

For further information about INGRES call 1-(800) 4- INGRES.
For information about SITE LICENSING and our Educational Marketing Program call Andy Ratoff, Industry Marketing Manager, at (312) 803-9500.

SCT

Systems & Computer Technology Corporation

- The SCT Systems Integration Center, SCT's suite exhibit and workshop at CAUSE87, featured the wide range of products and services that SCT offers as a systems integration partner for colleges and universities. A highlight of the exhibit was on-line demonstration of SCT's BANNER™ Series—the new standard for administration of ORACLE® with functional distribution of processing which operates in both IBM 9370 and DEC VAX environments. Information was also available on SCT's telecommunications services, information resource management services, and custom software development.

- Michael J. Emmi, Chairman, CEO, and President of SCT, offered a presentation exploring the world of systems integration and its importance in helping colleges and universities harness the power of their information resources. He examined how systems integration allows an institution to combine its information resources into a unified system that provides the facts that executives and administrators need to support their strategic decisions.

- SCT sponsored the *CAUSE/EFFECT* Contributor of the Year Award for the outstanding feature article published in the CAUSE magazine in 1987. The award this year went to Linda H. Fleit, President of EDUTECH International for her article, "Overselling Technology: Suppose You Gave a Revolution and Nobody Came?" which appeared in the May 1987 issue of *CAUSE/EFFECT*

UNISYS

Unisys Corporation

Networking: Today and Tomorrow

Laurie R. Jordaan
Director, Networks
Public Sector Systems Division
Unisys Corporation

It is accepted by today's society that we are indeed in a transition phase, moving from the world of data processing to the information age.

For most organizations, however, the picture is a bleak one. The evolution over the years in satisfying organizational and user needs has resulted in today's environment of multi-vendors, multi-architectures, multi-protocols, incompatible islands of information. Further complications are introduced when the need for investment protection, conformance to emerging international standards, advancing technology, and the spirit of American free enterprise are considered.

This situation was the focus of Unisys' presentation at CAUSE87, in which alternatives were addressed and strategies presented whereby organizations may utilize today's offerings to create a hybrid information environment and still position themselves for the future.

The clear message: communications/networking and interconnect products are the key.

Wang Laboratories, Inc.

In their CAUSE87 suite exhibit, Wang Laboratories, Inc., presented a selection of VS-based software solutions for colleges and universities, featuring demonstrations of Wang's relational data base, PACE, as well as WangOffice, Graphics, Word Processing Plus with Scientific Typing, and software solutions from Diversified Management International, Inc. (DMI) and Jeffery R. Shy Associates, Inc.

DMI, who participated in the Wang exhibit, has teamed with a group of higher education professionals to provide state-of-the-art applications to support admissions, student records, financial aid, business accounting, and development. Also participating was Shy Associates, which specializes in fund-raising and alumni-tracking software. Their Development software incorporates biographic and demographic data, and gift and fund accounting into one system.

SUITE EXHIBITS

The CAUSE National Conference has always offered individual vendor suite exhibits rather than an exhibition hall for the display of vendor products. Vendors have supported the decision, in spite of the extra effort and expense involved in setting up and publicizing individual suite exhibits, because they appreciate the informality and individuality that the format offers.

Vendors offering suite exhibits at CAUSE87 were:

- The AIMS Group
- American Management Systems, Inc.
- Apple Computer, Inc.
- AT&T
- Business Systems Resources, Inc.
- Campus America
- Computer Communications Specialists
- Control Data Corporation
- Datatel Minicomputer Company
- Digital Equipment Corporation
- Granada Systems Design with AT&T Conversant Systems
- IBM Corporation
- Information Associates
- Integral Systems
- Lasermax Corporation
- Prime Computer, Inc.
- Quodata
- Relational Technology
- Systems & Computer Technology Corporation
- Wang Laboratories, Inc.

SUITE EXHIBITS

CUPS
CUPS FEATURES

On The Light Side...

Evaluations turned in by conference participants consistently praise the opportunity to talk informally with colleagues. There is no question that an important part of the conference experience is the personal contact—both scheduled social events like the Registration Reception and the luncheons, and informal encounters between sessions or at casual dinners.

CAUSE87 featured two special get-acquainted activities in addition to the Registration Reception sponsored by **Digital Equipment Corporation**: a golf tournament on the beautiful Copperhead Golf Course sponsored by **Information Associates**, and the round robin tennis tournament sponsored by **Peat Marwick** on the Innisbrook Tennis Courts. Large numbers of registrants arrived a day early to enjoy these outstanding facilities.

Thursday night's "Country Fare" took place on the conference lawn under the Big Top—a real Southern country feast of whole crabs and crab claws, shrimp, barbecue, Polish sausages, baked beans and corn bread, and rows of pies, cakes, cookies, and ice cream treats. Diners saw more than one plate piled dangerously high with crabs. Following the feast, a brief but lively video film of conference activities, introducing Elmer Hesse of Wright State University in a starring role, brought screams of recognition and applause from a very receptive audience.

The formal agenda for the evening consisted of the presentation of trophies to the winners of the tennis and golf tournaments, and the drawing of two names for free Eastern Airlines tickets.

The evening's dancing was sparked by the impromptu but highly talented square-dance calling of Reed Davis of the University of Arizona, who couldn't resist the good country band.

CAUSE gives special thanks to vendors who sponsored the refreshment breaks which took such great advantage of the lovely Innisbrook weather and grounds: **Apple Computer**, **Control Data Corporation**, **Century Data Systems**, and **EDUTECH International**.

Pictures on these pages will help you relive some of the action at CAUSE87...

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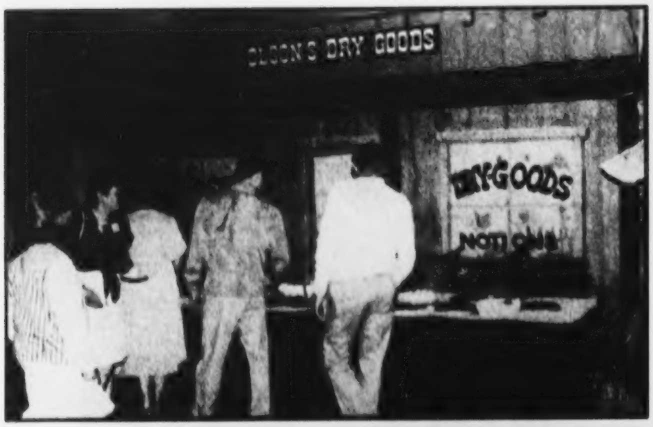
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